MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

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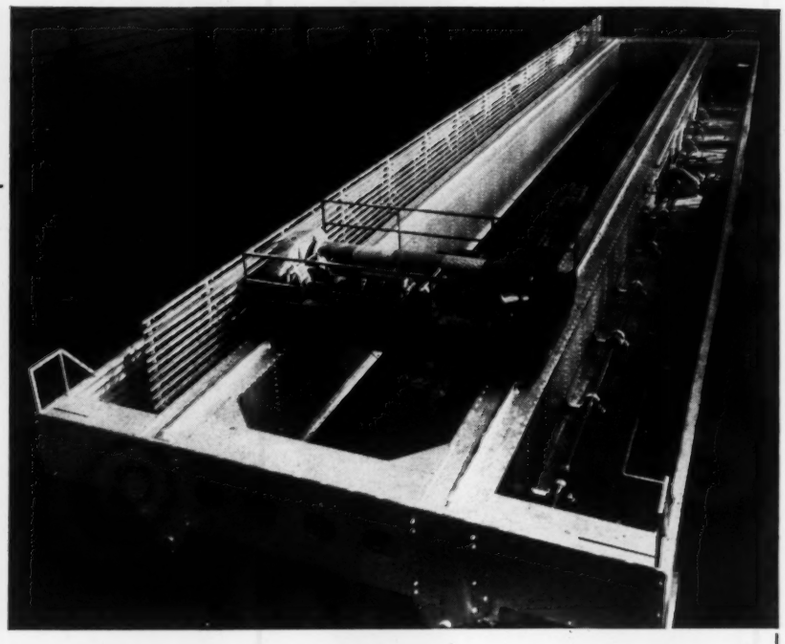
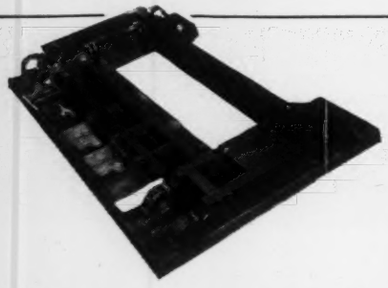
This traveling crane was improved by FLAME-CUTTING

This traveling crane illustrates an extensive use of flame-cutting by the Shaw-Box Crane and Hoist Division of Manning, Maxwell and Moore, Inc.





Flame-cut parts were used in the assembly of the trolley frame to assure maximum strength from minimum weight.

The irregular steel shapes for the end trucks supporting the trolley frame were flame-cut quickly and economically.

These gear blanks, assembled from strong flame-cut parts, were machined and put in use throughout the crane.

THIS 20-ton capacity, 120-foot span, electric traveling crane is light in weight—yet is exceptionally strong—because many of its parts were flame-cut from strong, tough, rolled steel. The light weight of this crane, achieved by flame-cutting and welding, increased its lifting capacity. It can carry ladles of molten metal to the molds faster—yet it consumes less power than earlier models. The time required to build it, and its overall cost, also were reduced.

Other Oxy-Acetylene Applications

Flame-cutting is one of the many applications of the oxy-acetylene process which are useful and profitable in the manufacture of equipment. Parts subject to exceptional wear can be flame-hardened or hard-faced. Where annealing is required, surfaces can be flame-softened. Parts, even when made of different kinds of metal, can be welded to form strong, smooth-finished and long-lasting units. Write any Linde office for additional information.

Recent developments in flame-cutting and flame-hardening will be among the features at the exhibit of Linde products at the National Metal Exposition, Detroit, Michigan, October 17-21, 1938. Plan now to visit Area B-221.

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Unit of Union Carbide and Carbon Corporation

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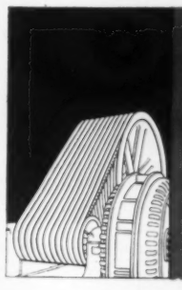
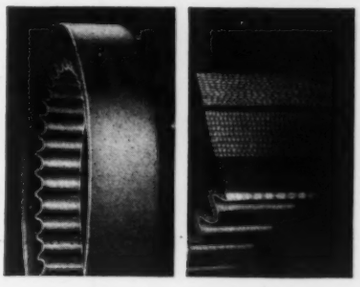


Dayton

COG-BELT DRIVES

MADE BY THE WORLD'S LARGEST D MANUFACTURER OF V-BELTS



Topics

TORPEDOES, which if they do not hit their mark turn around and try, try again, are one of the most recent developments in war armament. A patent describing this unique weapon has been assigned to John Hays Hammond Jr. and the invention promises to make the deadly torpedo an even more lethal device. Secret of the performance is a wire trailing from the torpedo that touches the bow of the ship being attacked if the torpedo misses the target. Contact of the ship with the wire causes an electrical switch in the torpedo to be actuated which in turn starts a small motor that turns the rudders of the torpedo. The direction in which the torpedo will turn is determined by the course of the ship it is aimed at, a manual setting of the torpedo being made just before it is fired. When one realizes the cost of a single torpedo is upwards from $10,000, the value of a device which makes doubly sure the weapon will hit its mark is considerable.

♦ ♦ ♦

War scares in Europe are proving a boon to engineers who must be responsible for and take charge of major rearmament programs. In England particularly, there is now a crying need for engineers and the British government is giving "special consideration" to all applications for repatriation of skilled engineers who migrated to the U. S. after the war.

♦ ♦ ♦

Discovered in 1863, indium now is reported as being used to produce a hard finish resistant to corrosion. The finish can be produced by alloying as well as by electroplating. Articles in automotive, electrical, dental and jewelry industries are employing it to advantage. Also discovered is that a thin layer of indium deposited electrolytically on bearing surfaces prevents corrosion due to formation of acids in lubricants. Indium is a lustrous white metal, soft and ductile. It melts at 155 degrees Cent. and boils at 145 degrees Cent. Added to other metals it increases surface stability and hardness.

♦ ♦ ♦

X-rays long have been used to study metals for interior defects, but because of the two-dimensional limitations it has been difficult to determine the exact depth of flaws from the surface of the metal. Today by use of the X-ray stereoscope and stereometer, special X-ray views not only show an internal flaw but further indicate, almost automatically, its distance from the surface. Former mathematical methods made possible the determination of this depth within, perhaps, a ½-inch error factor. The stereometer reduces this error to a 1/16-inch maximum.

♦ ♦ ♦

Porcelain enamel finish, resembling overlapping snowflakes, has been produced by a chemical crystallizing process which makes it possible to develop the pattern in any shape or design. The material forming the crystalline pattern is applied by either spraying or brushing, after the cover coat of porcelain enamel has been burned on. Then under the correct atmospheric conditions the material will dry into crystals of various shapes and designs which in due time become hard. Oxide pastes can be applied over this to form any of the wide variety of colors which are subsequently burned in the enameling furnace at ordinary temperatures to form the finish coat.

♦ ♦ ♦

Designers with artistic sense as well as technical ability are in high demand with the modern styling that is an important part of every machine today. W. E. Johnson of General Electric Co., in a recent paper, "How Useful Is Your Sense of Proportion" points out how necessary a good geometric sense is to the designer today and goes on to say:

"Unfortunately the highly technical man is only rarely endowed, to any high degree, with that combination of a fine sense of proportion, clarity of vision, and creative ability that is an attribute of the successful 'practical' designer. Indeed, I fear at times that intensive technical training tends to becloud and suppress these desirable attributes, that too much logical thought tends to crowd out the more artistic and spontaneous creative thinking that is also necessary in design. Be that as it may, the modern design department is usually faced with the problem of providing both technical and so-called 'practical' designers, and this in turn involves the problem of persuading these temperamentally different individuals to work together in harmony. The man is fortunate who possesses the talents for creative design and yet has a strong technical background."

MACHINE DESIGN

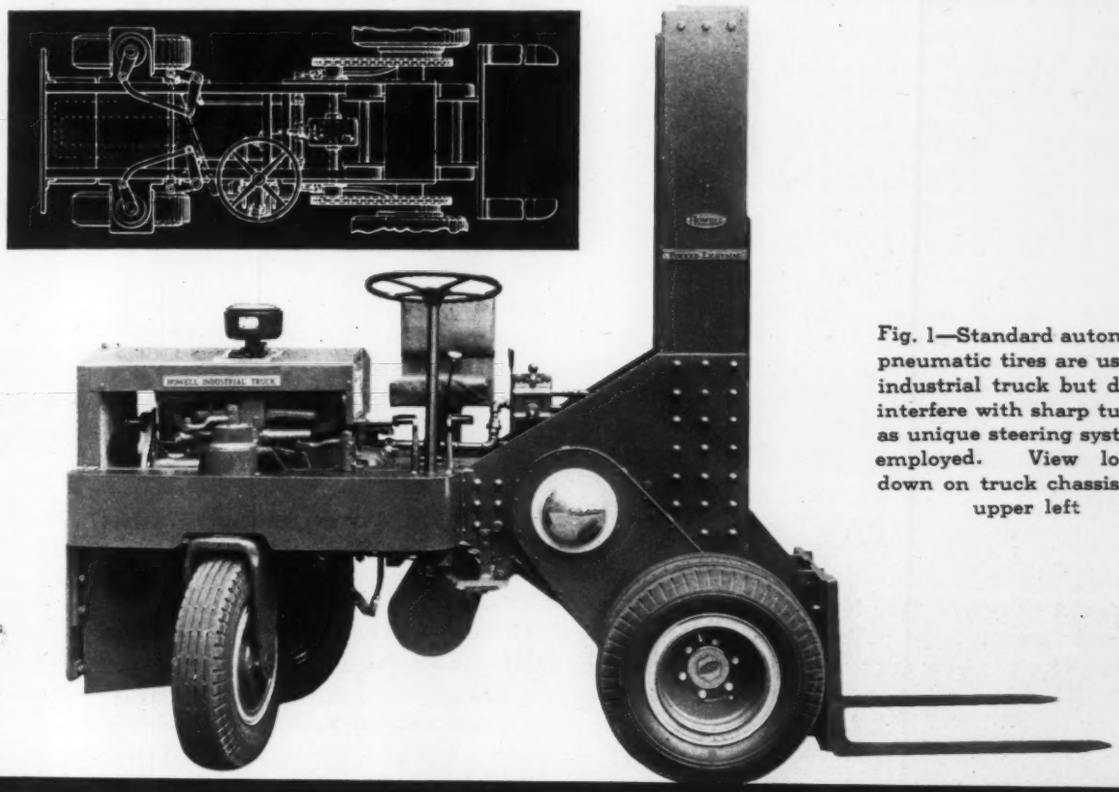


Fig. 1—Standard automotive pneumatic tires are used on industrial truck but do not interfere with sharp turning as unique steering system is employed. View looking down on truck chassis is at upper left

Design Is Simplified by Use of Standard Parts

By Walter Nichols

Chief Engineer
The Howell Industrial Truck Co.

IF low cost were no object in machine construction, it is probable that any competent design engineer could choose parts and materials, and specify fabrication methods that would result in an excellent machine. The difficult task, of course, is to turn out an excellent machine at minimum cost. In the early development of a machine the greatest consideration ordinarily is given to creating a design that is as near mechanical perfection as pos-

sible; later, when the design is proved and tested, design ingenuity is concentrated on building just as satisfactory a machine at reduced cost.

Industrial trucks, those scurrying vehicles around the shop which manage to lift loads far out of proportion to their size, have had an amazing growth in the past decade. Originally an expensive unit, their cost has been reduced by shrewd design until they are within the reach of even the small manufacturer. In the Howell industrial truck, (See *Fig.* 1) every advantage has been taken to utilize standard parts without sacrificing the operation of the unit in any way. For example, conventional pneumatic auto tires are used instead of the small hard rubber type usually found on industrial trucks. Although these standard-size tires presented a design problem in that they interferred with sharp turning, the difficulty was overcome and the Model 80 truck, which we will discuss, can turn in its own radius.

Perhaps the most interesting feature of the truck is the steering construction which gives such a small turning radius. It is designed with steering connections, drag link, and worm and cam sector above the truck body away from harm's way, instead of close to the ground where it might easily be damaged by floor obstructions. To enable the truck to turn in its own radius, using either one of the rear driving wheels as the pivot point and swinging the front end of the vehicle on this radius, as shown in the top view of *Fig.* 2, a different degree of turn of the front wheels is necessary. The two steering wheels, as can be seen in the lower view of *Fig.* 2, are actuated through a set of intermediate steering arms. The effect of these arms is to give the steering wheels different turning speeds, and at the same time perfect alignment for straight ahead travel.

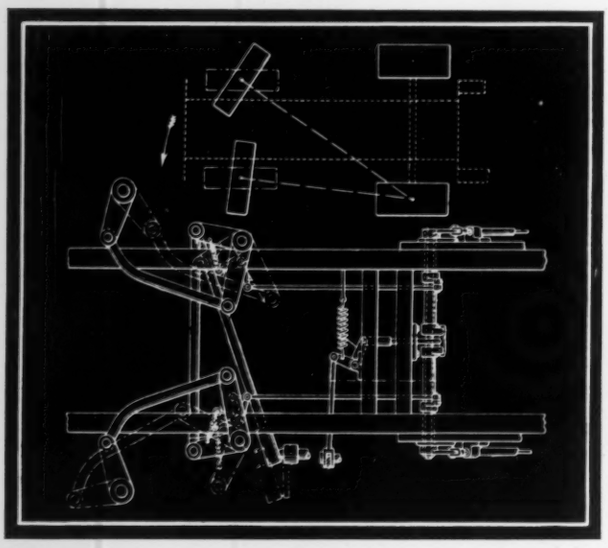


Fig. 2—Series of intermediate steering arms as shown in bottom view enable truck front wheels to turn different number of degrees so that vehicle pivots on either drive wheel. Diagram of turning radius is shown in upper view

When pivoting about the left drive wheel, for instance, the left front wheel is practically at right angles to the pivoting drive wheel; the right front wheel is in the position shown in the top view of *Fig.* 2, having turned about 15 degrees less than the left front wheel by reason of the pantograph arrangement shown in the lower view. As the machine pivots about the drive wheel, the brake on this wheel is automatically applied by turning the front wheels, allowing the truck to be carefully swung into a small space.

Each front wheel is mounted in a caster-wheel fork, made of alloy steel. The fork and supporting assembly are firmly riveted to the frame. As the truck carries three tons of counterweights on the steering end, a special steep-angle tapered roller bearing is placed in the lower end of each fork spindle housing. This bearing acts as a combination thrust and radial bearing, whereas the bearings at the top of the two housings are standard tapered roller design. Bearings are easily adjusted from the top of the housing.

The wheel itself also is suspended in two tapered roller bearings held in the hub by a cap on each side. Thus the wheel can be removed for tire service or repair by simply removing adjusting nut on the inside of the fork, and pulling out axle pin.

Dead Axles Used for Front and Rear Wheels

Dead axle design is used for mounting of the rear or drive wheels as well as front wheels. The axle is of 6-inch square alloy steel and it also supports the hydraulic cylinder base of the lift mechanism. Dead axles permit a rather economical construction and have the decided advantage of supporting the pay load and weight of the truck. No propulsion part is required to carry or help carry the load. Here again antifriction bearings were selected to mount the wheels. Each wheel is driven separately by a 1½-inch pitch roller chain, enclosed in a chain guard. This type of construction obviates the need of expensive universal joints and gearing and gives trouble-free power transmission. An eccentric at each driving sprocket permits ⅛-inch takeup steps.

Motive power of the truck is supplied by a standard automotive gasoline engine, solidly mounted on cross members of the frame. Cooling fan is of the six-blade pusher type, forcing air from the motor side of the radiator to the outside instead of the reverse which is the common practice. This system is used primarily to keep motor heat away from the driver and also to effect better cooling as the truck moves in reverse most of the time. Either special transmission with equal speeds in forward or reverse, or the standard Chevrolet transmission may be supplied with the truck. Either of the two

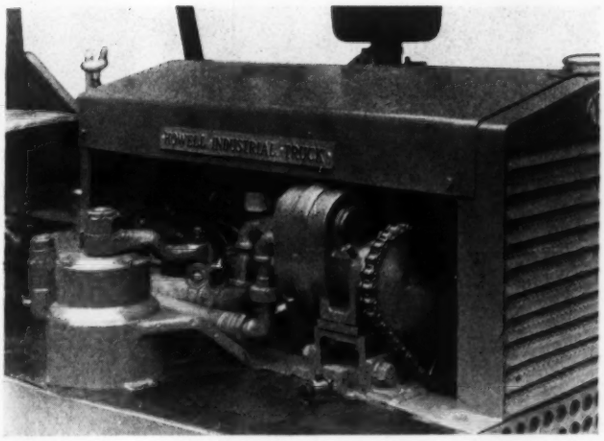


Fig. 3—Hydraulic pump is driven continuously from motor by roller chain and supplies pressure for lift cylinder

transmissions gives a speed reduction and resulting torque sufficient to spin the driving wheels even when the truck is fully loaded. Automotive differential is mounted just behind the transmission and each driving shaft is fitted with a sprocket for the chain drive to the rear wheels.

Brakes are mechanically operated and work directly on the drive wheels. This design prevents using the differential or drive shaft universal joint in the braking system. When we realize that 40 seconds of acceleration by an 85-horsepower engine is required to bring the truck to maximum speed, but only a few seconds are given for an emergency stop, it is easy to understand the terrific braking strain that would be placed on differential or universal joints if a drive-shaft brake were employed.

Heavy channels serve as side pieces of the frame. The vertical uprights are riveted and welded to high carbon steel gussets and act as guides for the load carrier.

For lifting the load-carrying forks a sleeve-type hydraulic cylinder with a 69 square inch effective area piston is used. See *Fig.* 4. Three leather packing glands effectively seal the top of cylinder to prevent oil leakage. Two lift chains of the roller type are employed and are anchored at one end to the base plate of the cylinder and the other end to the lifting member. The crosshead of the cylinder unit is equipped with two sprockets turning on a 2½-inch diameter bronze bushing, manually lubricated.

Other units of the hydraulic system included a continuously running gear type pump, driven directly from the front end of the engine crankshaft by a small roller chain as seen in *Fig.* 3. The pump is mounted on a hinged base, the chain takeup being made by means of a wedge forced under one side of the bracket. Employment of a continuously running pump eliminates the use of complicated clutches and linkage, thus reducing manufacturing expense and also making one less operation for the driver.

Oil is picked up for the hydraulic system from a

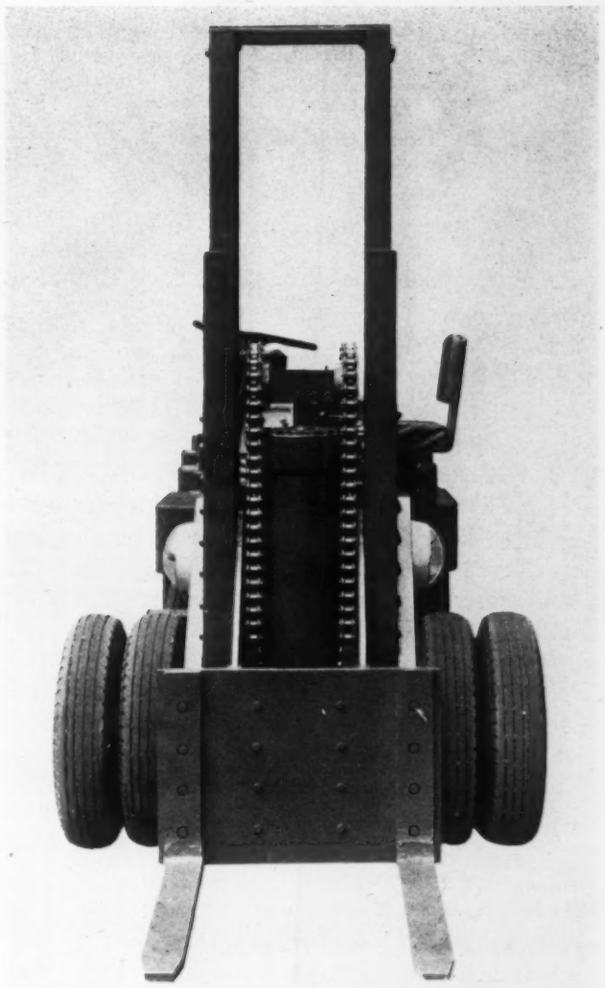


Fig. 4—Two heavy duty roller chains work on sprockets mounted on piston rod, thus raising load twice the distance the piston travels. Cylinder is substantially mounted on extra heavy dead axle

supply tank, located below the truck. The oil is under pressure from the pump only when the control valve, conveniently placed close to the driver, is in the "lift" position. At all other times the oil merely circulates through pump and valve and back to the supply tank.

A hydraulic lift system was specified for the Howell truck because it was the simplest, the easiest to control and of nominal cost. The gear pump is the only part that receives any appreciable wear and face plates that may be readily replaced are part of the standard equipment of this unit. A maximum pressure of 2000 pounds per square inch may be obtained with the pump. The complete hydraulic system as well as engine, transmission and differential are protected with drain plugs, containing a small but powerful magnet, capable of attracting and retaining foreign metallic particles that might lodge in the oil.

Few opportunities for simplification and lowered cost have been overlooked in the design, yet there has been no sacrifice in operating efficiency or long life.

Scanning THE FIELD FOR Ideas

SHOWN at the right, in *Fig.* 1, as it appeared during assembly at the East Pittsburgh works of the Westinghouse Electric & Mfg. Co., is an unusual vertical electric motor rated at 12,500 horsepower. This is one of six for the Metropolitan Water district of Southern California. These motors are the largest ever built for driving pumps.

They are of synchronous type and are designed to operate on 6900-volt, three-phase, 60-cycle current to give a speed of 450-revolutions per minute. They will drive single stage centrifugal pumps delivering 200-cubic feet per second against 440-foot head. Incidentally these pumps, which have been designed and built by the Worthington Pump and Machinery Co., also are the largest machines of their kind ever built.

The motors embody integral air coolers for self-ventilation and they are equipped both with exciters and with pilot exciters. Eventually ten of these huge units will be used, five in the Hayfield pumping station and five in the Eagle Mountain station. The required 125,000 horsepower will be furnished by the waterwheel generators at Boulder Dam, for whose current and line conditions these motors have especially been designed.

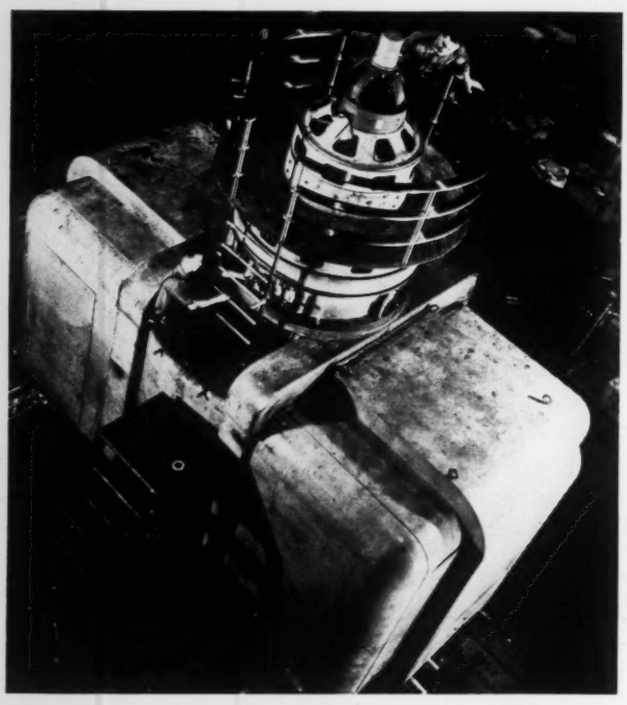


Fig. 1—This special motor designed for pumping service will require 12,500 horsepower from Boulder Dam

Reciprocation With Rotation

DEVELOPED recently for use in polishing machines which convert second and third grade steel sheets into first grade sheets, the Bantam bearing shown in *Fig.* 2 provides for reciprocation as well as rotation. It is an interesting commentary upon the spreading of a design idea, that this metal polishing machine bearing is now being adopted by designers of printing presses, particularly for application to inking rolls. To insure even spreading of ink, these rolls constantly reciprocate in a manner similar to that of the polishing rolls just mentioned.

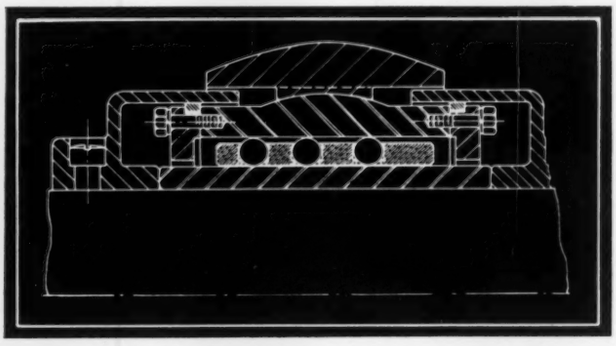


Fig. 2—This self-aligning ball bearing provides for reciprocation of its shaft as well as rotation

The bearing illustrated is designed to take care of shaft rotation of 800-revolutions per minute, and at the same time 60 reciprocations per minute, the extent of the latter being 1 inch. As the diagram indicates the bearing is made self-aligning by its globular ring. This insures equal distribution of load over all of the balls. The balls themselves are arranged in

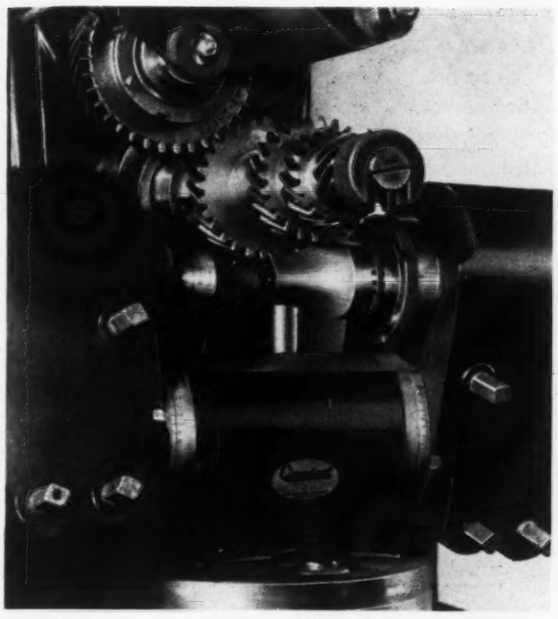


Fig. 3—Using fly cutters, this machine rapidly removes burrs from both sides of gear teeth

staggered formation to spread their action over the surfaces of the races, thus preventing the wearing of "tracks" in these surfaces. The races are made of SAE 52100 high carbon chromium steel and a bronze cage holds the balls.

Study of the diagram will disclose that the bearing is provided with seals of piston ring type which are in contact with shrouds extending beyond each end of the bearing. These shrouds are fastened to the shaft so that they revolve with and reciprocate with it. This system solves the problem of excluding dirt and retaining lubricant in this peculiar installation.

The effect of this bearing design development on the productive valve of the machines for which it originally was carried out, is striking. The savings effected through its adoption in steel mills is reported in some cases to have allowed writing off the entire cost of the polishing machine in three months time.

Gear Tooth Burrs Are Removed

ACCURATE burring of gear teeth at speeds as high as 800-teeth per minute is attained in the machine depicted by *Fig.* 3, which is one of the latest engineering developments of the Cimatool Co. The machine shown, which is one in a series of several sizes, will burr both sides or front and back of teeth on gears up to 8-inches outside diameter, a fly cutter being used on each of the two cutter spindles.

Main drive is by multiple V-belt, speed changes being effected by changing pulleys. The main drive revolves two trains of constant mesh gears, one of which drives the two cutter spindles which are mounted on a vertical column with up-and-down adjustment of 3¾ inches. This column is in the center of the machine and encloses the cutter spindle drive shaft. The cutter spindles are set horizontally opposed. They are adjustable toward and away from each other to the extent of 1½ inches and from front to rear through an arc of 60 degrees. A quick change timing adjustment for setup is located on each cutter spindle and allows adjustment to 1/600th of a turn.

The work gear idler swings upward to the left to accommodate various sizes of gears. It is driven through the second of the previously mentioned constant mesh gear trains, being positively synchronized with the cutter spindles so that the machine cannot get out of time. An automatic cycle control stops the spindles so that work always can be loaded and unloaded without interference. Timken bearings are used throughout and the machine has pressure lubrication and a built-in coolant system.

Multiple Action Cleans Air

CLEANING of air is becoming recognized as vital to the effective and economical operation of machinery which "inhales" large quantities of air—diesel engines, gas engines and compressors for instance. Shown in *Fig.* 4 is such a cleaning device developed by the American Filter Co., Inc., for which a patent has been applied.

Air entering through weather-protected screened

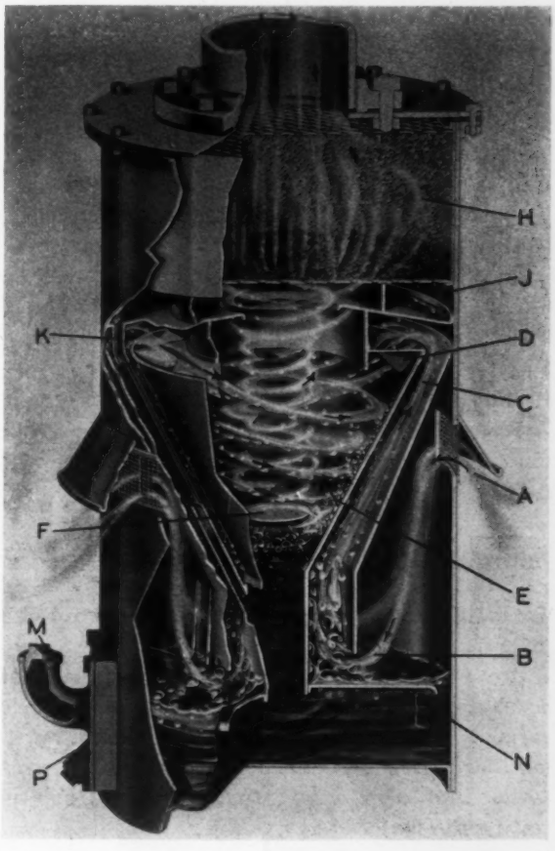


Fig. 4—Multiple action of this device removes grit and dirt from air for engines and compressors

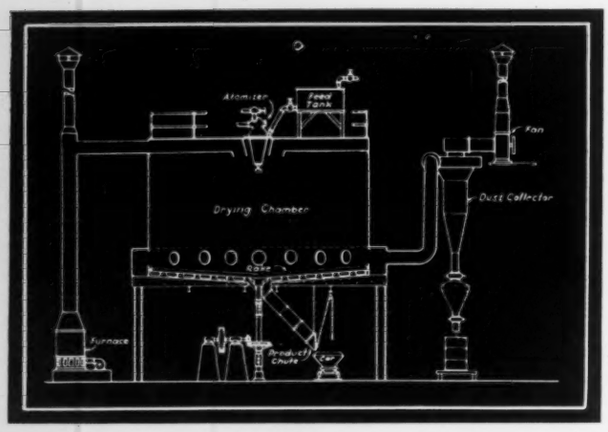


Fig. 5—As hot air is drawn through atomized wet material, solids are precipitated through flash drying

intake parts at *A*, travels downward to impinge against oil film covering plate *N* where the heavier particles are trapped. Increasing in velocity as it enters annular passage *C*, it entrains oil spray at point *B*, any dust present being thoroughly mixed with this spray. Part of the dust is then removed by scrubbing effect of the air against oil-coated walls as it travels through annular passage *C*.

As the stream abruptly changes direction to flow downward into cone *E*, slanting vanes give it a whirling motion. Spiraling downward with increasing velocity, most of the dust and oil are thrown by centrifugal force to the inner wall of the cone, from which it flows by gravity to a reservoir. Plate *F* prevents the swirling air from entraining dust-ladened oil at the tip of the cone.

The air finally passes up through the center of the cone to filter cell *H* which removes the last traces of dust and oil spray, clean air passing out through *R*. Oil which accumulates in the filter travels outward to the low velocity area near the circumference. Thence it drains into annular chamber *J* connected to the reservoir by tube *K*.

Dust and grit settle to the bottom of the reservoir, while lint and other light particles are caught under curved plate *N*. The reservoir is drained through plug *P* and refilled through *M*, a removable plate providing access for cleaning out residue.

Flash Drying Precipitates Solids

FLASH drying is proving to be a successful method of separating solids from a solution, slurry or mud by atomizing the wet material in a heated atmosphere. This evaporates the water and the dry material is collected as a powder. A similar method called flash chilling consists in atomizing molten material into a chilling atmosphere, thereby precipitating the material as a powder.

Apparatus for commercial flash drying, as designed by Industrial Associates, Inc., is shown diagrammatically by *Fig.* 5. The atomizer, which may be either electrically or steam driven, runs at 10,000 revolutions per minute. It is suspended in a cylindrical chamber to which air is admitted after being heated by gas, oil, coal or waste gases, this depending upon the circumstances surrounding the installation.

The wet material flows or is pumped on the atomizer bowl, atomization taking place on a horizontal plane near the top of the chamber. As the heated air passes through this plane of atomization, drying is almost instantaneous. The dried product jells like snow to the floor of the chamber from which it is discharged to a car or conveyor, in a manner clearly shown in the diagram.

Exit gases and some dust from the dried product are drawn out of the chamber through a cyclone dust catcher or wet scrubber.

Laminated Shims Insure Fit

COMPLICATED and expensive means for adjustment often can be avoided through the use of laminated shims, as in the case illustrated by *Fig.* 6. The machine shown is a shaper manufactured by the Atlas Press Co.

In a machine of this kind it is highly important that the ram shall slide freely but without any shake and it is important that this condition shall be maintained throughout the life of the machine. Therefore, its designers have specified laminated shims under the hold-down gibs.

At original assembly an accurate fit of the ram is obtained by peeling the shims as shown in the illustration. These same shims also enable the user, in the same manner, to make adjustments for wear.

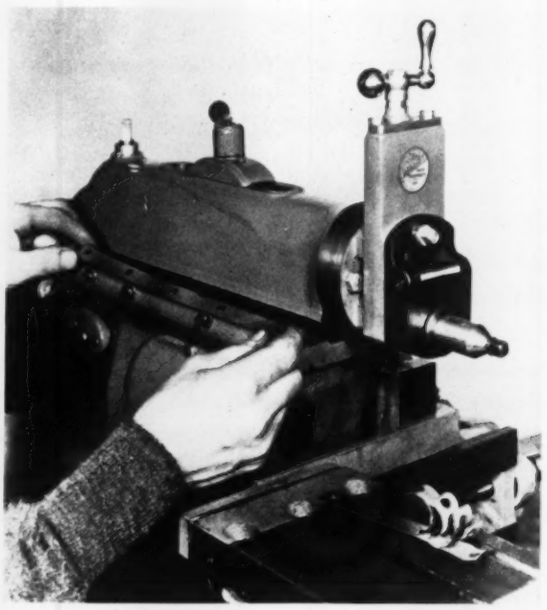


Fig. 6—Shims from which thin layers can be peeled are used under holding down gibs of shaper

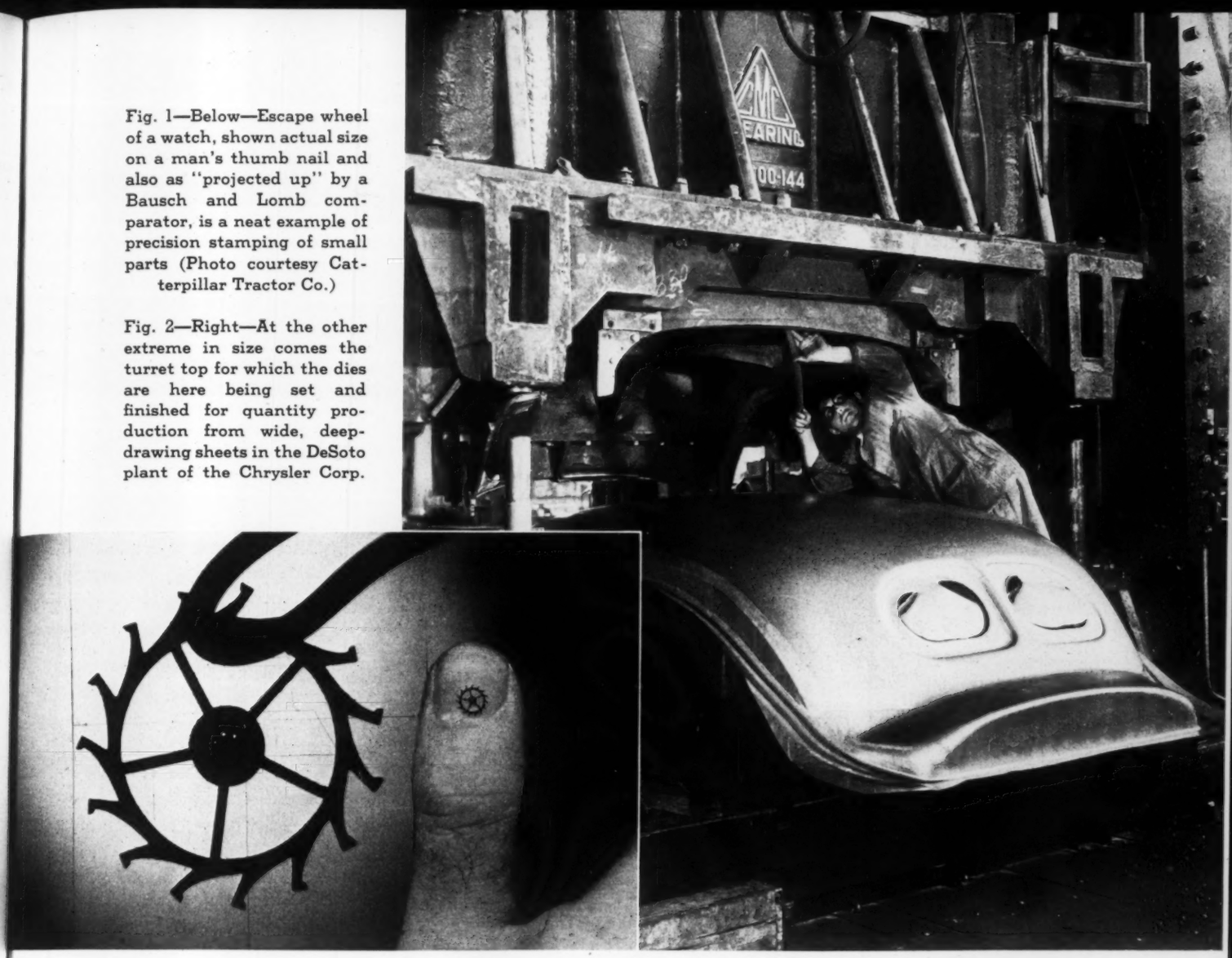


Fig. 1—Below—Escape wheel of a watch, shown actual size on a man's thumb nail and also as "projected up" by a Bausch and Lomb comparator, is a neat example of precision stamping of small parts (Photo courtesy Caterpillar Tractor Co.)

Fig. 2—Right—At the other extreme in size comes the turret top for which the dies are here being set and finished for quantity production from wide, deep-drawing sheets in the DeSoto plant of the Chrysler Corp.

Stamped and Pressed Metal Parts In Modern Design—Part I

By Guy Hubbard

ABOUT 1840 Chauncey Jerome introduced a one-day brass clock which could be made for less than 50 cents. In 1842 he shipped his first consignment to England. They were promptly confiscated at their invoice price by the customs authorities for undervaluation. This was perfectly agreeable to Jerome, as it furnished him with a spot cash buyer at full price—with no selling expenses. He therefore sent another and larger shipment, which shared the same fate. When a third still larger consignment arrived, the authorities withdrew from the clock business and let it in."

The foregoing paragraph, which we quote from the book *English and American Tool Builders* by Dr. Joseph W. Roe, well exemplifies the low costs attained in mass production through the adoption of stamped metal. The surprising thing about this phase of interchangeable manufacturing is that its technique and economy is as little understood by some machine designers today as they were by those customs officials almost one hundred years ago.

Having been a major factor in making low-priced Yankee clocks and watches famous the world over, the use of stamped and pressed metal spread into and

further developed in the fields of hardware, sewing machines and typewriters. Finally it penetrated the automobile industry. There it has shown its most remarkable development and has had its most sweeping effect. Automobile designers today actually "think in stamped and pressed metal."

There certainly is a vast contrast as far as size is concerned between the escape wheel of a watch, and the turret top for an automobile which are pictured in the heading of this article, as *Figs.* 1 and 2. These

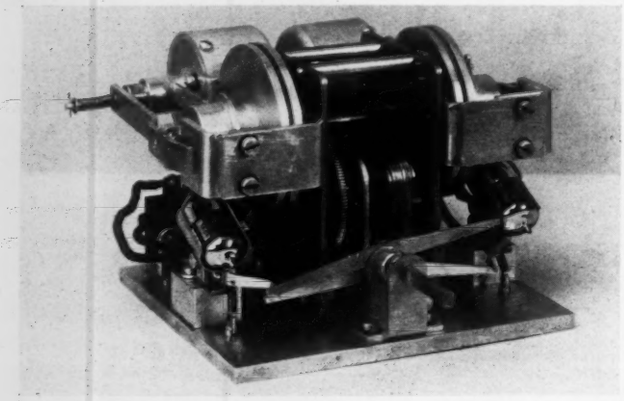


Fig. 3—This timing device, and its Barber-Colman motor, embody several simple stamped and formed parts

parts are alike, however, in that both are produced in presses from sheet metal—rapidly, accurately and at low unit cost. They do in truth make real the dream of one of the fathers of the interchangeable system, who believed that the day would come when machine parts would somehow be made in quantity lots "—each one as like every other one in the lot as are the successive impressions of a copper plate engraving."

To the machine designer who ponders over the foregoing and other examples of stamped and pressed metal parts shown in this article, the first thought probably will be "Can this or that part of my machine be made in this way?" In view of the remarkable things which are now being done with strip and sheet metal in dies, the chances are that the answer to that is: "Yes." To be convinced, look at and into any recent model of automobile, washing machine or business machine.

The next question will be: "Should I make these parts from stamped or drawn metal?" This hinges largely on the quantity required—stamping and drawing admittedly being a quantity production proposition. It may be, however, that these parts can be produced economically in much smaller quantities than the prospective user might suppose. There are ways and means whereby dies can be simplified for the effective production of relatively small lots in many cases. Dies admittedly are expensive, but so also are special tools, jigs and fixtures, the need for which is to a large extent avoided when stamped and drawn parts finished in the dies are adopted.

Then too, "What about the investment in press equipment?" The fitting retort to that is: "Why invest in press equipment?" Somewhere—probably not far away—there is a custom manufacturer who has this equipment and who has the experience to say with authority whether or not your parts should be made of pressed metal and if so, how they should be designed.

One such maker of stamped and pressed metal "parts for the trade" sums up the whole situation in this manner: "In the use of all materials and processes, good design must be approached not only from the standpoint of possibility but also from that of practicability. Most any metal part can be produced by stamping and forming but the cost of producing it will vary greatly, dependent on seemingly minor details of design. The manufacturer of stampings should be freely consulted on every detail of design if cost is a consideration. He can be of utmost service to the prospective user while the project is still in the design stage. At that time above any other he will be able to suggest minor changes in design details which—by reducing the original cost and the maintenance cost of the dies—will effect a substantial reduction to the user in the ultimate cost per piece."

Recent improvements in the strip and sheet materials used in press work have had a great influence on design and production by this method. This is true particularly of steel. To keep pace with the automotive industry, deep drawing stock has been developed which is of benefit to manufacturers of

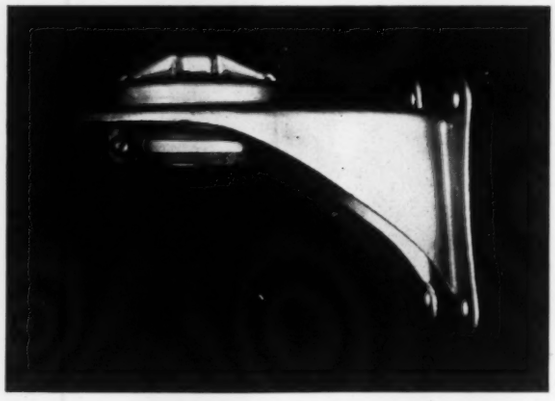


Fig. 4—Press-formed from sheet steel, support for Air-Maze filter is light but extremely strong

many other products. For instance, tubs for washing machines which used to require three operations for drawing to full depth, are now produced successfully by a single draw.

Then too, recent improvements in the quality and manufacture of coiled strip have opened new possibilities in the design and production of stamped and pressed parts—especially in connection with the use of automatic feed press equipment. Not so long ago the writer participated in a general "overhauling"

of the manufacture of sheet metal fasteners used in the automatic glazing of sash—this on the basis of recent developments in coiled strip.

These fasteners had for many years been made from soft sheets 3-feet wide by 9-feet long, that being the only material originally available. These sheets were laboriously "stripped" at the rate of 120 per minute in a hand-fed machine. Then the 3-foot strips, which were none too smooth, were punched at one

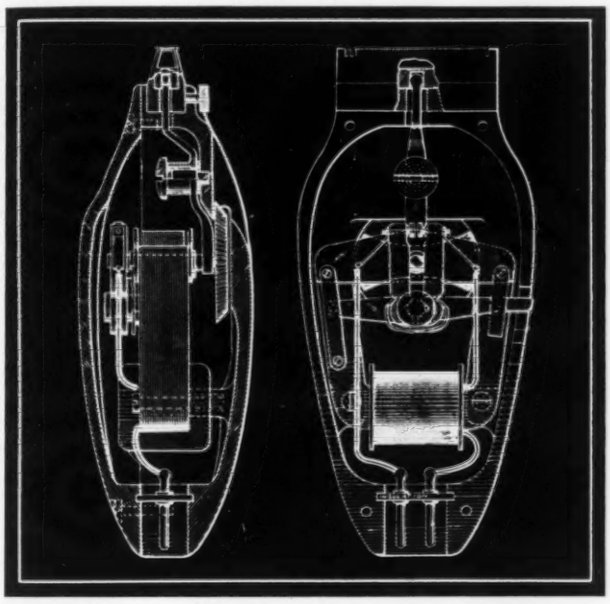


Fig. 5—Patent drawing of Schick dry shaver indicates effective use of stampings in construction of motor

end, strung on pins in a feeder frame holding ten strips each. After shearing the lower ends of the strips at an angle, the frame was placed on a blanking machine into which the material fed by gravity, the fasteners being blanked, stacked and cemented in rows of ten at the rate of 240 blows per minute. Boxing was by hand.

With the co-operation of companies specializing in the cold rolling of bright strip we obtained narrow coiled material in long lengths which was sheared lengthwise in a rotary slitter at an extremely high rate of speed. These long strips, of which there were ten, were wound side by side on a reel with separators. From this reel they were fed by rollers through a straightener into a blanking machine which operated at over 500 blows per minute. This high speed meant that an automatic boxing attachment had to be developed.

The net results of this project, which was based entirely upon improvements in strip and its manufacture in long lengths in coils were: Speeding up the process to at least three times its former rate through direct increase in speed and elimination of handling time; reduction of scrap loss to a mere fraction of its former amount through use of long, accurate material; and improvement of the product because of the mechanical and metallurgical precision of the modern strip stock.

The various illustrations used in this introductory article have been selected with the idea of giving to machine designers in various fields a quick though necessarily rather "sketchy" conception of the general possibilities of stamped and pressed metal parts.

To those interested in simplicity and low cost in their parts it is worthy of note that the details of the motor and timer shown in *Fig.* 3 are for the most part of such design that they can be blanked, punched and bent in relatively inexpensive dies. There is little or no "three dimensional forming" in that mechanism. The same is probably true to a certain extent of the details shown in *Fig.* 5, although the chances are that these precision parts have been through shaving dies as well as blanking dies.

The supporting bracket depicted by *Fig.* 4 is rather more intricate in design than this side elevation might indicate. Actually it flares out toward the rear to give lateral stiffness. This called for forming and deep drawing which gave the die makers and stamping specialists some headaches before the present satisfactory results were attained.

Parts such as the clutch body shown in *Fig.* 6 (the third part from the right) are numerous in the automobile industry and are becoming more common

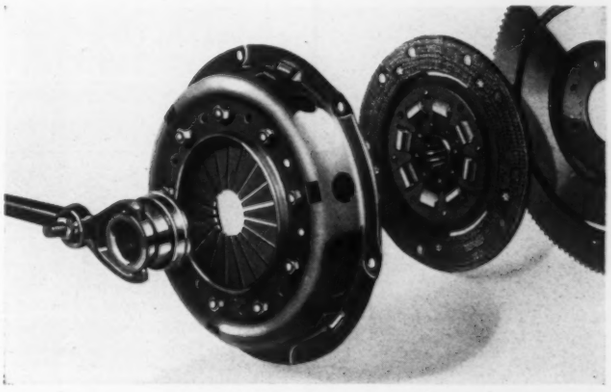
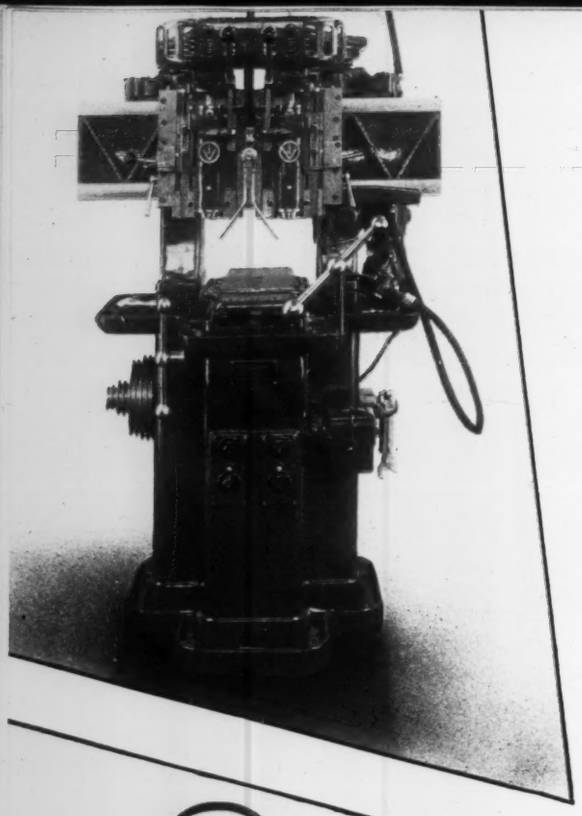


Fig. 6—Main member of 1938 Chevrolet clutch is a stamped, punched and drawn part of heavy gage steel

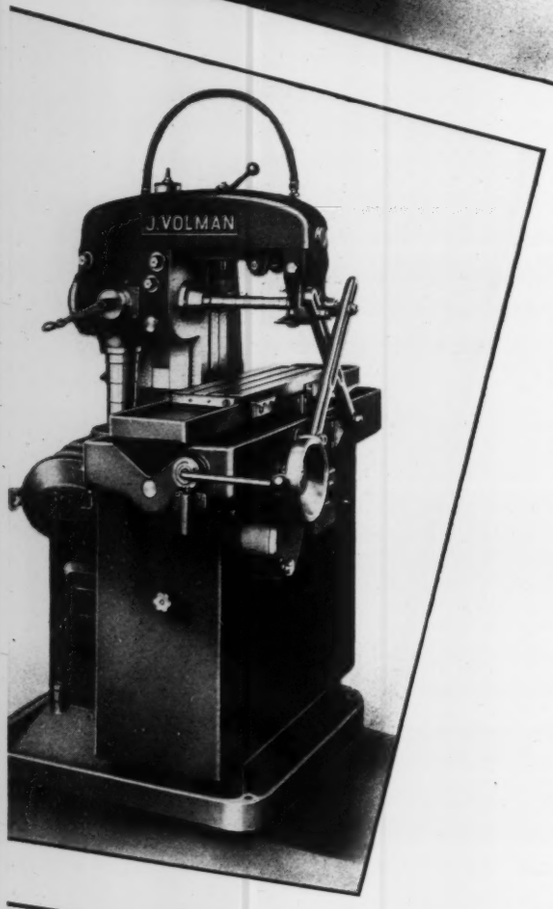
in connection with washing machines, agricultural implements and some other devices subject to quantity manufacture. A thing like this, however, ordinarily does represent die costs which prohibit its consideration as a detail in—let us say—a machine tool made in small lots.

While it is not to be expected that the average designer will need or care to delve deeply into the highly specialized subjects of die design and the working of sheet and strip metal in presses, we will in the next instalment of this series seek to draw aside the veil of mystery far enough to get some useful impressions of "what is doing" in the pressed metal industry.



Are We Keeping Ahead of European Machines?

By Alfred Wasbauer

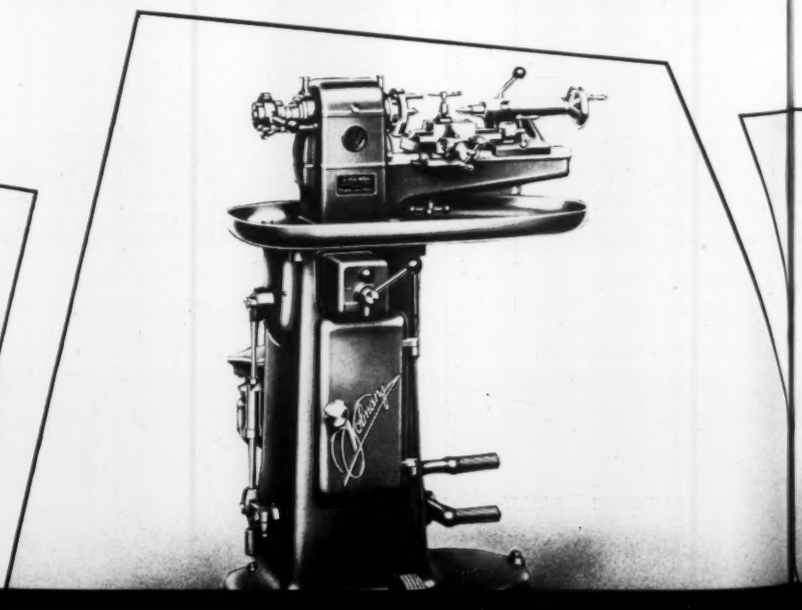


WHILE it is a fact that American machine tools have for more than seventy-five years enjoyed wide popularity abroad, there is growing evidence that the leading European nations are striving as never before to achieve self-sufficiency in the manufacture of these basic machines. While sales of American tools in Europe will continue to be heavy during the current rearmament race, American builders realize that normal demands for their machines in Europe are likely to grow less.

Adoption of successful American designs by European machine tool builders—with modifications to suit differences in production methods and manufacturing condition—has long been practiced. In most cases this situation has been accepted by the American machine tool industry as a tribute to excellence, rather than with any feeling of resentment. A number of friendly arrangements have been effected between leading American and European machine tool builders for exchange of designs and of patents.

At the same time there have been many interesting and wholly independent design developments on the part of foreign machine tool builders. American engineers frequently find these to be of considerable interest even though many of them have to do with conditions which are strictly European. On these two pages an effort is made to reflect something of current European machine tool design through illustrations and brief descriptions.

Consider the illustrations around this two-page spread in a counter-clockwise direction. The one in the upper left hand corner is of a Volman two-spindle profiling machine, a product of Czechoslovakia. This machine is adaptable to milling shapes of irregular outline, following a master former. V-belt drives are used, with independent drive to each spindle, there being 16 speeds ranging from 225 to 4500 revolutions per minute. The



heavy main side on which are mounted the right and left-hand vertical slides is mounted on rollers to insure free action.

Next below the profiler is a Volman version of the familiar "plain" or "Lincoln-type" milling machine. This follows in general the lines of comparable American machines of this type, rigidity being the prime factor sought. This type of machine was much more commonly used in America some years ago than it is today, high production machines having largely superseded it.

In the lower left hand corner is depicted the headstock of the full hydraulic lathe called the "Calzoni Hydromatic," built in Bolognia, Italy. This is designed for full-automatic operation on high production bar and chucking work. On a common shaft within the headstock are two vane-type, variable delivery pumps. The larger supplies a hydraulic vane-type, pressure-balanced motor which drives the spindle through reduction gearing. The other pump supplies the power for the rapid traverse of all tool slides. Working feed of the slides is provided by four small pumps, each controlled from the headstock.

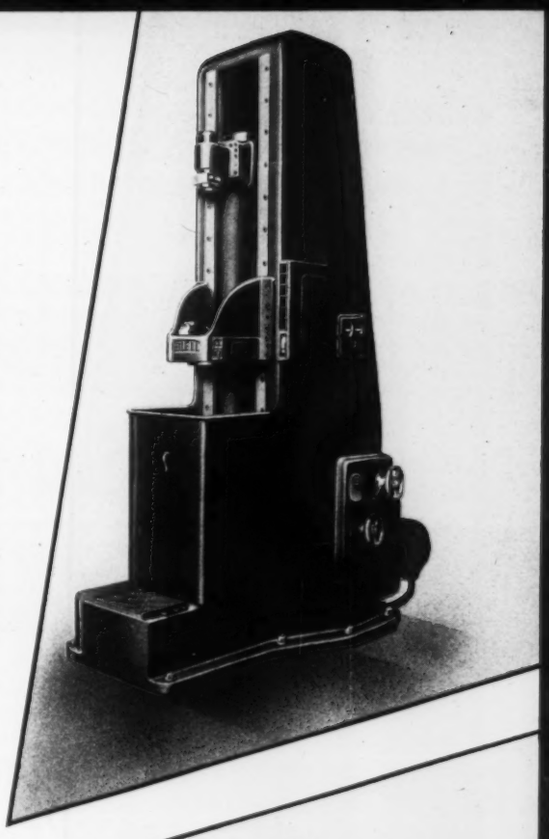
Next to this, at the bottom of the page, is a Volman precision tool maker's lathe of rather distinctive design. This machine has centers 3-9/16 inches above the bed, with 8⅝ inches maximum between centers. A ¾-horsepower motor is mounted on the back of the pedestal and the spindle has six forward and reverse speeds—maximum forward being 3000 revolutions per minute.

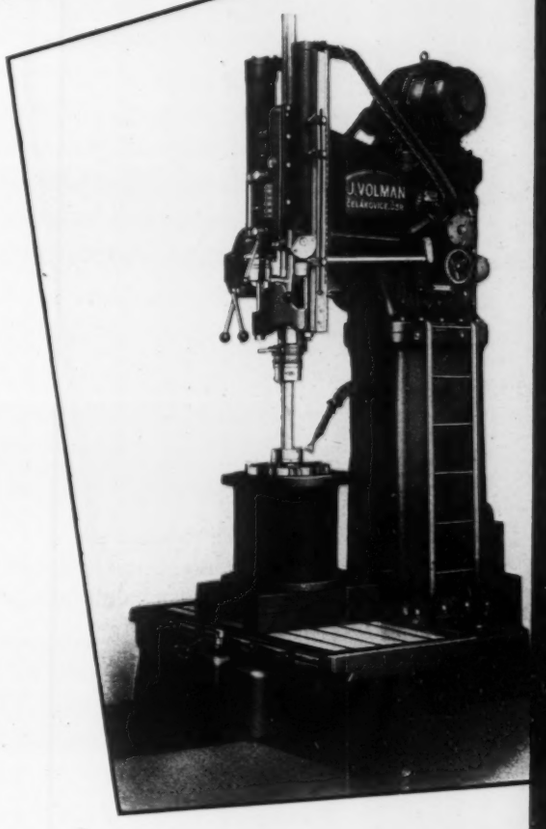
Then comes something not strictly a machine tool—this being the "Skoda-Savin" wear-testing machine, another Czechoslovakian product. Incidentally this machine demonstrates that hardness as gaged by Brinell, Rockwell or Scleroscope methods is no sure index to wearing quality. In this machine the periphery of a small, smooth tungsten carbide disk revolving at high speed, is brought to bear on the test piece. The amount that this disk penetrates the sample in a given number of revolutions at given pressure serves as the basis for figuring the wear-resistance of the material.

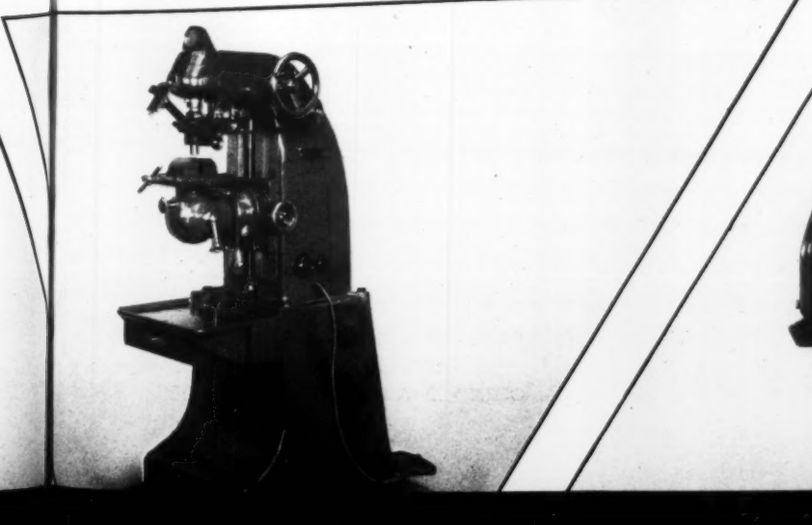
At the lower right hand corner of the spread there is pictured one of the Volman heavy-duty engine lathes with geared head, antifriction bearing spindle, quick-change gear box and lead screw for thread cutting. The lead screw of this machine can be reversed without reversing the spindle. While the lines of this machine will look somewhat severe to American designers, and they may question the location of certain controls, it looks very practical.

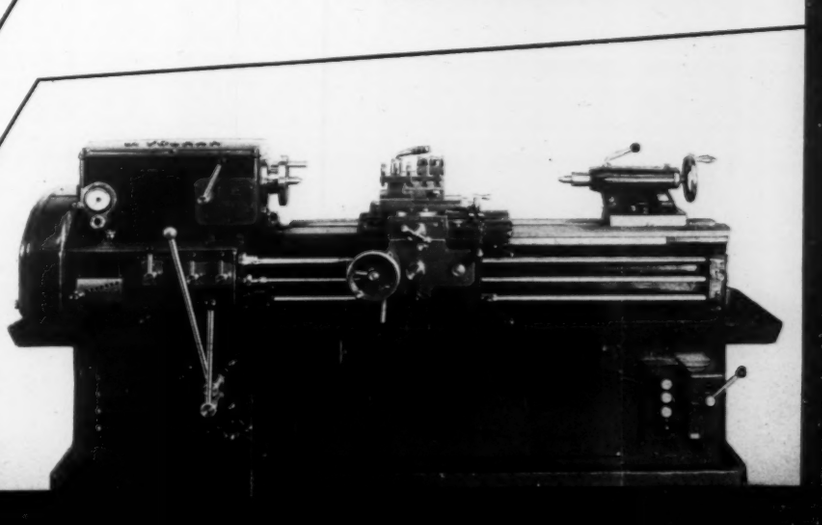
Above it is shown in action a Volman hydraulic grinding and honing machine with top-mounted motor and hydraulic drive mechanism. Note the dual traction cylinders on the vertical head, which are energized by the "Enor" oil pump system. The motor drives through V-belts.

And finally, at the upper right hand corner, there appears what is by far the most attractive appearing of all these machines. This internal and external broaching machine of hydraulic type, built by Paul Blell at Zeulenroda, Thuringia, Germany. The designer has in this case taken advantage of welding to create a frame of really outstanding appearance and simplicity. In addition to the convenient controls the designer has provided a "luminous panel" at the right side of the frame, by which operation can be judged by colors.









Designers Should Kno

Courtesy, Sherwin-Williams Co.

By the application of two colors in scientific manner to small bus a very definite streamline effect is obtained

By David Donovan

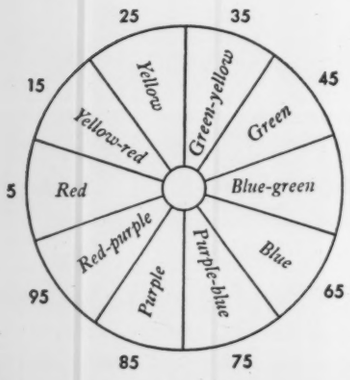
WHEN Professor Piccard made his first stratosphere flight the gondola of his high-climbing balloon was painted conventional black. As the balloon ascended the gondola grew oppressively hot. In fact, the temperature climbed to more than 100 degrees Fahr., and the professor may well have wondered whether he was going toward heaven or in an opposite direction. What happened, of course, was that the black-painted gondola absorbed an uncomfortably large proportion of the sun's rays.

For his next ascension Professor Piccard tried a white gondola. This time, the gondola grew chillier and chillier, for the white deflected most of the sun's heat. Finally, a gondola painted half black and half white was designed, and this happy medium kept the temperature on stratosphere jaunts at pleasant levels.

Who would think that a "little thing" like color could be so important in the design of a stratosphere balloon?

Color's esthetic value is generally appreciated, and it is well known as a beautifying agent. Design engineers also know how important a part color can play in practical industrial applications, but the psychological and physical values of color are not so widely recognized.

Psychologically color is important to industry. Properly applied to plant machinery it can improve the efficiency of the workers and contribute to their general morale and well being. In a large shoe machinery



An isosceles triangle placed on hue chart will point to three colors well suited for a combination. Colors that are opposite on the chart are good for contrasting

Color Psychology

plant in New England it was found that the simple expedient of painting machines and factory walls in bright, cheerful hues improved the morale of the workers and reduced the accident rate. Experiments in Germany and Switzerland dating back to 1920 indicated that bright colors, particularly reds, applied to factory machines and walls exercise a beneficial, psychological effect on workers. These stimulating colors apparently increase the worker's efficiency and help to speed production. Many American factories have recently switched from the conventional grays and blacks to more exciting colors for just that reason.

The extent to which color affects mental processes is illustrated in the February issue of the *Canadian Medical Journal.* An article tells of color being used in mental healing. Melancholic patients are cheered and stimulated when placed in red rooms or when treated under red lights. Violent cases are subdued with cool colors—generally light blues and grays.

Contrasting Colors Ease Eye Strain

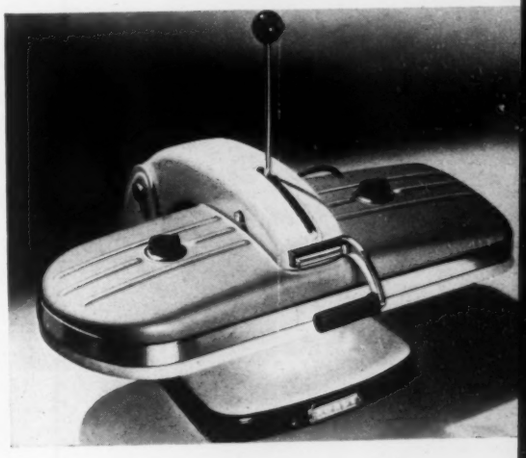
An intereesting psychological use of color was made in a large factory in Massachusetts where the machine operators were having trouble with their eyes. Machines (stitching) were painted black, and so were the working parts. The material being stitched was dark in color and, consequently, there was little contrast. The factory manager suggested that the workers repaint their machines in lighter and brighter colors—any colors they chose.

This was done. The factory looked like a kaleidoscope after all the machines had been redecorated according to the individual tastes of their operators. But results were excellent. First of all, complaints from eyestrain disappeared. Moreover, each worker took such pride in his newly-painted machine that he kept it spotless.

It is almost too obvious to mention that machines are often painted bright colors to reduce the danger of accidents and contribute to ease of operation. It is now common to paint valves, levers, handles, and other moving parts in direct contrast with the rest of the machine. Thus the operator finds it more convenient to handle the controls—he can see them at a glance. A large electrical manufacturer paints all jib cranes in a modernistic black and white striped design to make them stand out plainly. Workers find it easy to avoid these moving cranes since the attention value of this color combination is so striking.

There is a factor of monotony built up where a machine is painted in a single color—particularly if that color is a sombre one. The worker's mind tends to become quiescent and inactive under such an influence, and he begins to move automatically. This may lead to accidents, or to careless work. Where machines are colored in active, vibrant hues, and when the various parts of a machine are distinguished by contrasting colors, the factor of monotony is eliminated and the danger from accidents reduced.

In the design of a machine the first requisite of color is utility; esthetic values are secondary. Obviously, no machine should be painted in a hue that will fade after protracted exposure to sunlight or in one that is so light it will show oil marks immediately, no matter what the qualities of esthetic appeal may be.



Dull pastel shade is used on surface of ironer to reduce glare and eye strain

By painting furnace equipment such as stoker in bright color with attractive trimming, a desire to keep machine clean is created

But the esthetic side of color design must not be neglected. Machines and tools are designed to perform some useful mechanical function but, even more than that, they are designed to be sold.

How can color be used most effectively? There are no hard and fast rules for color selection. In fact, some color experts maintain that *any* colors can

properly be used in combination, provided the designer is skillful enough to use the right proportions. One good general rule for color combination is the complementary color principle. It is always safe to use complementary colors for an attractive and pleasing effect. And these complements are relatively easy to determine. The "hue circuit" given at the beginning of the article shows how to pick complementary colors; in the hue wheel each hue is directly opposite its complement.

For three-color combinations, a simple rule to follow is that of the triad. An isosceles triangle placed on the hue circuit will rest, of course, on three colors. These three hues may be used in effective and pleasing harmony.

Bright glossy finish of meat scale gives sanitary effect and is easy to clean

A handy table of the reflectance properties of various colors follows:

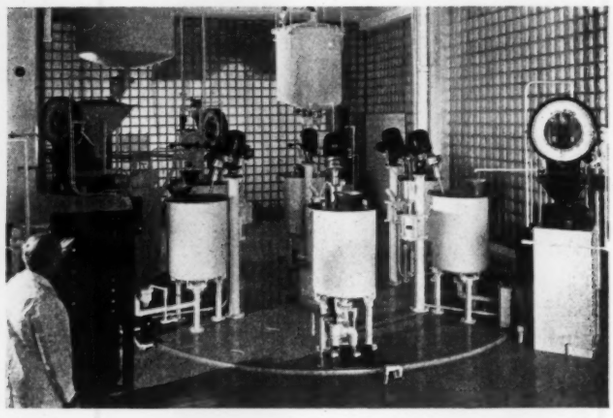
Color	Per Cent	Color	Per Cent
White	89	Pale green	59
Canary yellow	77	Bright sage	52
Cream	77	Silver gray	46
Orchid	67	Olive tan	43
Cream gray	66	Forest green	22
Sky blue	65	Coconut brown	16
Buff	63	Black	2

This list of colors raises an interesting point. What do you consider a "canary yellow" or a "coconut brown"? Your idea of these colors may be entirely different from your paint manufacturer's thoughts on the subject. His "canary yellow" may be called "corn yellow" or perhaps, "No. 6 yellow" by another manufacturer.

There is a definite need for a more exact method of color identification and specification. Ordinary color names are meaningless and confusing, except for the most rudimentary uses. Fortunately, there is hope for improvement. Professor A. C. Hardy of Massachusetts Institute of Technology has invented a machine called the recording photoelectric spectrophotometer which identifies and analyzes more than two million colors in terms of light reflectance properties. Each color has a distinctive wave band, and the spectrophotometer plots this band automatically on graph paper.

Thus, colors can be matched scientifically by comparing graph curves, or they can be specified with precision in terms of these reflectance properties. Several companies like Interchemical Corp. and General Electric Co. which must match and specify colors daily, are already using the Hardy machines. It is possible that in a few years engineers may be asking not for light reds, pale yellows, or dark greens, but "color wave lengths 615, 515, and 510."

In concluding this article on color as a factor in design engineering, it seems appropriate to quote a statement made some years ago by Dr. Luckiesh, director of research for the "Better Sight" Laboratories at Nela Park. He said, "I've been preaching color for over twenty years—its fundamentals, its use as a light reflector, as a decorator, as a delineator of personalities. I predicted that it would have an ever-increasing effect on product sales. I also believed that architectural exteriors and industrial machinery would be the last to utilize its values, but that eventually they would succumb to its possibilities."

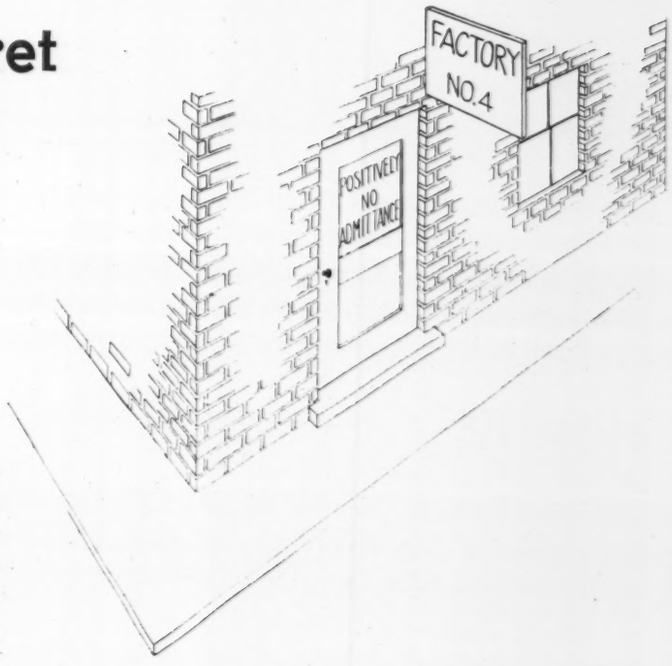


White porcelain enamel finish on this group of salve mixing machines contrasting with motors and other equipment painted black gives pleasing appearance

Industrial machines *are* "succumbing" at last to the call to colors which already has rallied the designers and merchandisers of consumer products. The possibilities which an intelligent use of color offers to industrial designers in utility and in sales values are becoming more and more evident. And engineers, noted for being practical men, are applying common sense rules of color which make the most of these opportunities.

Manufacture of Parts May Be "Valid" Trade Secret

By George V. Woodling



IN MACHINE development, designers often make worthwhile improvements by discovering new and better methods of manufacturing the parts that enter into the machines. Improvements may relate to a reduction of machine operations to make the part; to a saving in the salvaging of waste material; to the rearrangement of the production line or schedule; or to other manufacturing details designed to speed up production and reduce the unit cost.

Because of the technical or statutory requirements of patentability, many of these improvements cannot be patented. Yet notwithstanding the lack of patentability, they are of considerable importance to the company originating them as such improvements give the company a considerable price advantage over competitors. In these cases, experience shows that it is advisable to keep the improvements secret from competitors and the general public. One ordinarily looks upon trade secrets as relating to chemical processes and the products made thereby, but it is well to keep in mind that trade secrets may relate to the manufacture of machine parts as well.

Copyright, 1938, by George V. Woodling

IT is not always possible to obtain protection by a patent. In the accompanying article, Mr. Woodling, author of INVENTIONS AND THEIR PROTECTION, discusses the advantages of trade secrets as a means of guarding developments. Even though such developments involve manufacturing processes rather than pure design, the design department should be adequately informed on this subject because of the interrelationship between departments of machinery building companies and the possibility of being able to apply the knowledge to advantage

Trade Secrets Must Be Carefully Guarded

To constitute a real trade secret, the owner must take every precaution to conceal it. Machinery and equipment for carrying out the trade secret or process must be protected behind closed doors, and visitors and even general workmen prohibited from entering. It is considered highly important to display a notice at the entrance of a segregated part of a factory where the secret is practiced reading: "Positively No Admittance" or words conveying the same precaution. If details of the secret are known generally to all the employes of the company it is not a real trade secret, even though the general public may not have acquired knowledge of it. If the process for carrying out a so-called trade secret is accessible to plant visitors, it is not a real trade secret even though the visitors may fail to notice the process as they are walking through the plant.

Oftentimes, manufacturing concerns do not stress the importance of keeping certain processes a secret until it is too late. As soon as the secret is discovered lawfully, the discoverer has a full right to practice the

invention. In other words, once the secret becomes known, the owner has no legal remedy by which he may regain the exclusive ownership he formerly enjoyed.

Many law suits involving trade secrets result from betrayal by trusted employes. In such cases the Court cannot give much practical help as it usually develops that the guilty employe has no financial responsibility, and consequently a judgment awarded the owner of a trade secret is usually uncollectible. However, it is well established that the Court can enjoin the guilty employe from disclosing the secret to others or from using the trade secret in establishing a business of his own. If the employe discloses the trade secret to another manufacturer who attempts to use it, the Court will enjoin the offending manufacturer. The following abstract of a decision involving the manufacture of worm gears represents the general attitude taken by the Court in giving relief against the misappropriation of a trade secret by a distrusted employe:

> "The Plaintiff here was a corporation engaged in manufacturing worm gears for autos. The defendant was employed by plaintiff as shop foreman and was discharged. The defendant started to form a competing company to manufacture worm gears.
>
> The Plaintiff asked for an injunction, claiming the process for making the gears was a trade secret. The defendant's defense was that the knowledge for making these gears was not secret.
>
> The Court found that a perfected or precisely similar gear to that made by the plaintiff could not be reproduced without knowledge of the process or without long experimentation as employed by the plaintiff in developing said gear. The injunction was granted."

The Court said in part:

> "Under all the circumstances detailed in the evidence, it appears clear to the Court that the relation of trust and confidence existing between the plaintiff and defendant was of such a character as establishes an implied contract that the defendant would not do the things the evidence conclusively shows he has done and proposes to do."

Employee Should Be Under Written Contract

In cases where the trusted employe is under no written contract to keep the trade secret confidential, it is sometimes difficult to prove to a court that the relationship between the employe and the company was one of trust or confidence and that an agreement not to divulge the secret was implied. Therefore, to guard one's interest, it is good practice to have a written contract between trusted employes and the company providing for the maintenance of trade secrets.

To invoke the protection of the Court the owner must show that the trade secrets were genuine and clear cut. It sometimes happens that an alleged owner, because of insufficient general knowledge, innocently attempts to reclaim as a secret that which was formerly publicly known. Such knowledge is not a real trade secret. Nor is there a trade secret when the product is one of mere mechanical skill as opposed to a product of the creative faculties. The same high creative level as demanded for patentable invention is not required of a trade secret, but it must be something more than that which an ordinary mechanic skilled in the art would produce if called upon to solve a particular problem.

Difference Between Patent and Trade Secret

With respect to those improvements which rise to the dignity of invention, an established policy should be formulated between the design and manufacturing departments to serve as a guide in determining whether or not the improvements should be protected by a patent or be guarded as a trade secret. As an aid to establishing this policy, it is well to bear in mind the legal distinction between a patent and a trade secret. There are many decisions pointing out this distinction of which the following quotation is illustrative.

> "The difference between secret processes and patents is that the owner of a patent has a monopoly against all the world, while the owner of a secret process has no right 'except against those who have contracted, expressly or by implication, not to disclose the secret, or who have obtained it by unfair means.' * * * The jurisdiction of equity to protect such trade secrets is founded upon trust or confidence. The court 'fastens the obligation upon the conscience of the party, and enforces it against him in the same manner as it enforces against a party to whom a benefit is given, the obligations of performing a promise on the faith of which the benefit has been conferred.' * * * Whether the subject matter is patentable or not, if the designer discovers and keeps secret a process of manufacture, though he will not have an exclusive right to it as against the public after he shall have published it, or against those who in good faith acquire knowledge of it, yet he has a property right, which a court of chancery will protect against one who in bad faith and breach of confidence undertakes to apply it to his own use."

In electing to guard the invention as a trade secret, one should estimate at the outset the risk involved in attempting to keep the secret from leaking out. If there is a likelihood that the secret might eventually become known and if the invention is patentable, the safest plan is to file a patent application. An inventor of a process who uses it in secret for several years, at the same time placing the product on public sale, cannot later—when difficulty is encountered in protecting the secret—obtain a valid patent.

No general rule can be set as to whether an invention should be maintained as a trade secret or protected by a patent. Each case must be decided upon all of the surrounding circumstances. If it is decided to maintain the invention as a trade secret then every precaution must be taken to maintain that secrecy.

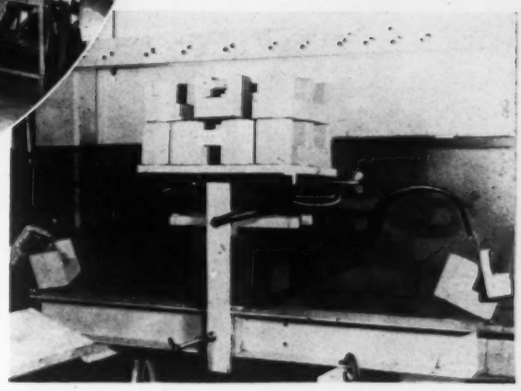


Fig. 1—Checking the structure of the Douglas DC-4 is among the most complex of testing problems. A simple test shown at right, however, can give the answer to many a question of strength or rigidity

Be Doubly Sure—Test It!

Part III

By A. W. Ross Jr.*

A STATIC test, intelligently conceived, carefully conducted and properly interpreted can prove invaluable in influencing design toward maximum efficiency and minimum cost. Such a test need not be elaborate. The designer himself can use a corner of the shop and, without specialized equipment or any great expenditure of time and money, set up and conduct a very satisfactory test. A simple structural test is depicted as an example at the right of *Fig.* 1, while at the left is shown an extensive test of sections of a huge transport plane.

THE "LABORATORY" AND PERSONNEL—With the test specimen available and the loading scheme prepared, the test can proceed. A space will be required that we will glorify by the term "laboratory" in which to conduct the test. The floor should be relatively level and clean. If a building column is accessible to the test space it will provide an ideal anchorage for the jig or fixture. Plenty of light and a minimum of noise are desirable. Generally, a specimen gives ample notice of approaching failure by the sound of cracks and groans. Lack of ideal conditions, however, need not make tests any less accurate or valuable.

The information from the test can be expected to be most comprehensive if the man in charge has reasonable structural training, a working knowledge of mechanics and strength of materials. Experience is always an asset but, beyond this, ingenuity is the important requirement. Such help as is required may be gleaned from the shop, maintenance crew, drafting room or office.

TEST EQUIPMENT—The equipment required for any test depends upon the specimen to be tested, the magnitude of the loads to be applied and the data which it is proposed to collect. This discussion will be kept general to include the range of possible tests. Certain equipment, for loading, measuring the loads and measuring deflections, has general application for any contemplated test.

JIGS AND FIXTURES—The specimen dictates the jigs and fixtures. A loading scheme will have been

*Engineer in charge, Structures Laboratory, Chrysler Corp.

worked out in accordance with the basic premise *to duplicate the actual conditions.* The jig is designed so that the computed loading scheme is realized in test.

The jig structure should be rigid and of sufficient strength to provide for complete failure of the specimen without jig yield. This insures that the loading scheme will be maintained throughout the test and not be affected by jig distortion. A quick and conservative stress analysis of the fixture often is worthwhile. Jigs may be of steel, welded, bolted or riveted together; or of wood bolted or nailed. The material and equipment available dictate the design, which usually can be worked out and built up without drawings. Simplicity is the key to good jig design, and the anchorage available influences this design. Jigs may be so constructed that the test is self-contained and requires no external anchorage; they may clamp to building columns (See *Fig.* 2) and thus simplify the construction. A steel plate clamped to a column has proved useful as a fixture for mounting small tests. The specimen, together with small supplementary fixtures, is bolted to the plate through holes drilled as required.

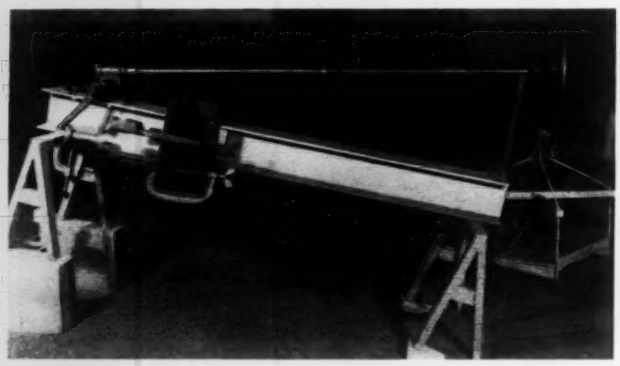
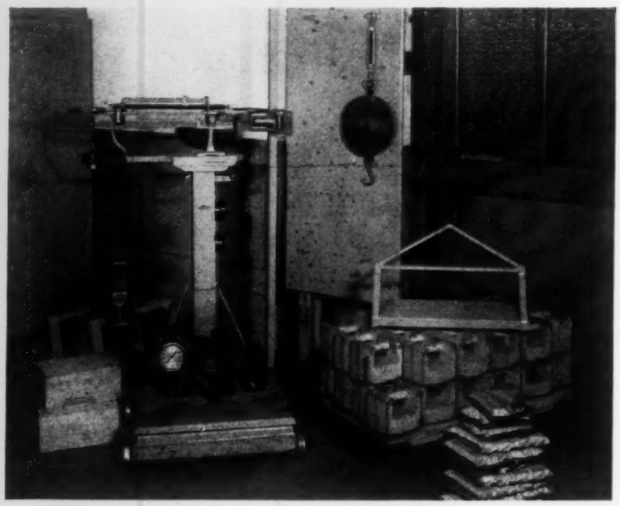


Fig. 2—No external anchorage is necessary for this test, self-contained on the beam. Wheel loads are introduced through a quadrant on rim

Fig. 3—Simple test equipment may include a vertical plate anchored to floor, and scales, jacks, weights, trays, blocks and beams



LOADING METHODS—Loading methods are of two kinds. Weights may be applied to the specimen, either directly on its surfaces or in a tray hung from loading points, as best meets the requirements of the loading scheme. The use of weights has the disadvantage that, unless special precautions are taken, failure is accompanied by complete collapse. In fact, secondary failures may follow the primary failure so closely that the primary failure cannot be segregated. By mounting a safety structure under and just free of the specimen or tray, the amount of collapse can be controlled to some extent.

Jacks Advantageous for Loading

The use of jacks as a loading medium eliminates this undesirable feature of loading with weights. With jacks, when yield or collapse starts, the load at the jack is automatically reduced and complete failure does not occur without additional movement of the jack. A turnbuckle operates similarly to a jack except that a tension load results, with corresponding requirements of anchorage not required of the compressive jack load.

Leverages can be utilized with advantage to increase the capacities of available jacks or weights. In fact, small I-beams with rods welded on to serve as positive load location points are useful equipment. In *Fig.* 3 we see an assortment of apparatus for producing test loads.

Jacks and weights have their most usual application for vertical loads, and set-ups are made so that the loading is most conveniently accomplished. Where loads in other than a vertical direction must be used, one method is to use a pulley, cable, tray and weights. Bell cranks adapt themselves to some set-ups, and jacks can be used at any angle so long as provision for supporting the jack is made on the jig.

Lead Is Handy for Test Weights

MEASUREMENT OF MAGNITUDE OF APPLIED LOADS—When weights are used, the actual weight in pounds is known from preliminary calibration. Lead is the most satisfactory material for test weights because of its lack of bulk, and it easily can be cast to any desired weight within reasonable limits. A proper shape for stacking and handling is desirable. Units of 50 pounds are considered a maximum convenient weight for ease of handling. For lesser weights, small pigs of lead in units of 5, 10 and 20 pounds have many applications. More common is the use of lead shot sacked in convenient units; sand is also a satisfactory material.

Platform scales, used in connection with jacks, provide the means for determining jack loads. Hydraulic

jacks may be fitted with pressure gages that give the load directly. Where turnbuckles are the loading device, a "fish scale" (spring balance) can be inserted in series with the turnbuckle.

MEASUREMENT OF INTERNAL STRESSES—Measurement of stresses requires more specialized equipment. Most tests give essential data without stress-measuring instruments but they do have important applications. The "strain gage" is an instrument in general use and there are a number of types on the market which are familiar to the engineer. The instrument measures the change in length over an established gage length, from which data the stress can be computed. The deformation, which usually is small, is multiplied and read on an indicator dial. Small electrical gages also are now available.

Special Instrument for Testing

An instrument which has been used with considerable success by the author is the DeForest scratch extensiometer. Because of its small size and low cost it has applications not open to the more standard instruments. Briefly, it consists of an arm and target. One end of the arm is provided with small grits embedded in a mastic and these grits bear against the polished face of the stainless steel targets, scratching a line when displaced. The arm is two inches in length. With the other end of the arm and the target soldered in position, a two-inch gage length results. Near the soldered end of the arm, the flat metal of this arm is twisted through 90 degrees so as to be perpendicular to the plane of the target, providing a spring so that the grits can be moved across the target face.

For static testing, a zero line is scratched on the target by displacing the arm sideways. Then, for each load increment, the arm is moved slightly to register the grit positions. The longitudinal distances between scratches of one particular grit (the one giving the best defined record) are the actual changes in length in the two inch gage length of the instrument. This distance can be measured under a microscope or miscroscopic photographs taken and the distance measured with a scale. Being very compact, a number of gages can be installed on a specimen. If the arm is displaced to its full travel from the center of the target it will work back toward the center, under repeated loads, due to the spring action of the arm and the difference between static and moving friction. The target may then be made to give a service record that has a definite application in obtaining actual stresses of service.

Stress patterns can be made visible by the use of resin, or ester gum can be obtained from paint manufacturers for this purpose. The specimen to be tested is coated with a thin layer of resinous material, and load is applied. When properly controlled, tension and compression cracks appear in this material at well below the yield point of the material of the structural specimen, and critical points (stress concentrations, etc.) stand out in bold relief.

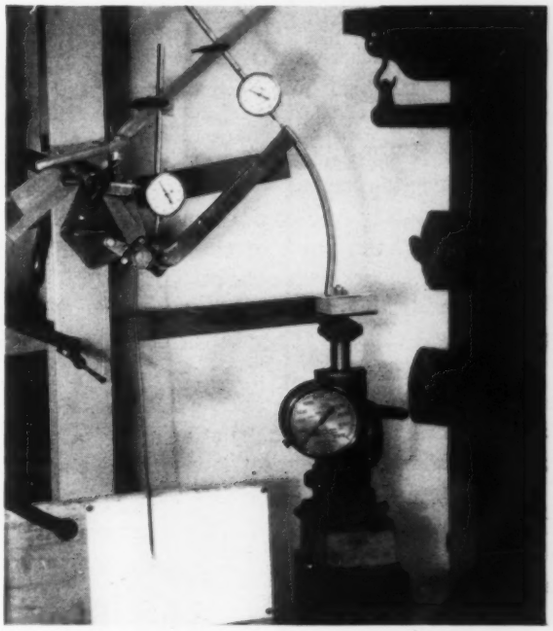
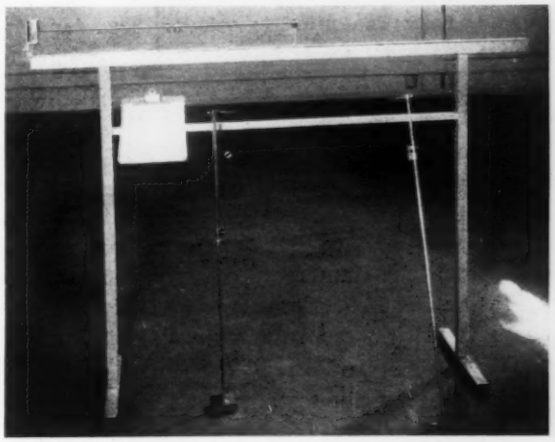


Fig. 4—Deflections of auto foot pedal are obtained by using indicators. A pointer, moving across a target, gives angular deflection of the supporting part

Fig. 5—Trammels of the "self-plumbing" as well as the usual type are used in testing. The scale, graduated in hundredths of an inch, is mounted on a convenient stand



Some skill is required to apply the resin smoothly to the test surface. It must be melted and maintained molten, then applied and flowed onto the surface of the specimen. The specimen must be preheated and a minimum temperature differential between specimen and resin maintained if temperature cracks are to be avoided. A little practice will develop a technique that will give good results. The stress cracks require

some study for their interpretation but valuable results are obtainable. Photographs of the cracks can be taken by a skilled photographer.

Deflection measurement is an important part of any test. When it is necessary that the specimen be not destroyed or where several tests are to be conducted on the same specimen, deflection may be the sole basis for test conclusions. Deflection data provide the most convenient means for establishing the yield point and for locating the critical section. In *Fig.* 4 a common set-up for measuring deflection is shown.

Small deflections usually are measured with a high degree of accuracy (.001 inch) by means of indicators. The bearing of the point of the indicator arm is of importance. Accuracy may be seriously affected if the specimen, under load, is displaced sideways from the indicator arm causing the point of contact to change.

Direct measurement to $\pm$ .02 inch or closer can be made with trammels. The author has worked with an instrument of all-steel construction using a telescoping tube and rod with close tolerances for the bar.

The usual trammel consists of two parallel points adjustable on a bar of wood. A draftsman's compass is easily adapted to serve for a measuring instrument and a mechanic's dividers can serve in many cases.

Trammels for Height Gaging Are Useful

An instrument dubbed "self-plumbing" trammel has found considerable use. This is in reality a height gage and operates from a plane surface as seen in *Fig.* 5. A concrete floor, if reasonably level but in no sense a true plane surface, may be used as a base for relative measurements with such a trammel, as long as the point being measured is not displaced far enough to move the base away from its initial position.

Measurements are taken to prick punch marks on the specimen, the measurements being read on a scale preferably graduated in hundredths of an incch. For self plumbing trammels, special support is provided.

TEST PROCEDURE—The jigs are made up and the set-up prepared to give the desired loading scheme and to give the data most directly with the equipment at hand. Measurements to be taken are decided upon and prick punch marks established and referenced.

Before starting the test, inspect the set-up from the standpoint of *safety*. If the specimen is of thin material there is little or no danger of flying parts. But if highly heat-treated members are a part of the test assembly, there may be no warning before ultimate failure and flying parts may constitute a serious hazard. A large amount of energy may be stored up in a seemingly harmless set-up. A proper understanding of the potentialities of such stored energy by all concerned is a safeguard and actual guards may be erected for protection. Where lead weights are used, a framework just clear of the trays and structure should never be omitted; a broken cable would let the whole weight down on an unguarded foot. Top-heavy stacks of weights never should be permitted. The responsibility lies with the engineer in charge, because helpers cannot be expected to appreciate the possible dangers of unpremeditated failures.

Before proceeding with the test it is good practice to preload the specimen to eliminate "slop" in the joints. In general, after preloading, the initial deflection increment is more in line with subsequent increments than when preloading is dispensed with. The load applied for this purpose should be kept so small as not to approach the yield of the specimen.

Initial measurements are taken and the test proceeds in increments with measurements taken for each particular predetermined load. It is much better to take too many than too few readings since, with the greatest of accuracy, errors will develop that require fairing on the final curves. During the course of a test, it is suggested that the load be re-

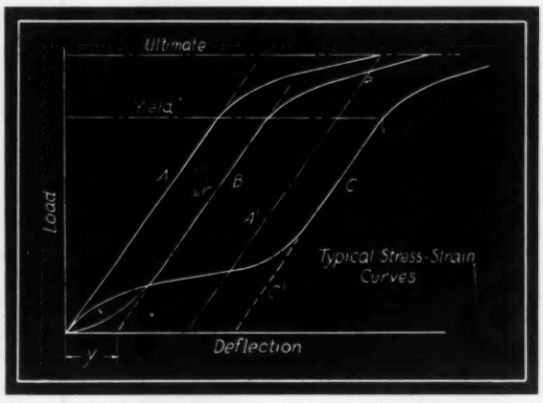


Fig. 6—Readings are usually plotted with load as ordinate and deflection as abscissa to give the standard stress-strain form

moved and the initial readings repeated. Thus, permanent set can be determined. In the case of a simple specimen, set may be interpreted as indicating yield. However, for complex specimens and built-up parts, some set invariably occurs after even small loads and it is necessary to interpret the data in the light of the complete results. In most tests, some particular measurement can be made to serve as an indication of yield. In general, the increments of change in such a measurement will remain constant over a considerable range. Then, for greater loads, these increments will increase. This increase is a criterion of yield. If the specimen is not to be destroyed, the test must be discontinued. Or, if the test is to be carried to destruction, the load at which collapse and failure will occur can be anticipated.

At the first indication of yield, witnesses to the final failure may be called in. All those who have had any

contact with the development of the part or assembly are eligible and in a position to add to their knowledge by seeing the part fail. A great deal of practical interest can be aroused by a test properly staged.

TEST RESULTS AND THEIR INTERPRETATION—The actual testing merely provides the test data which include:

(1) the ultimate strength.
(2) the critical section as indicated by the failure.
(3) relative deflections of the structure.

In addition, there may be stress patterns as indicated by resin, or measured stresses obtained with strain gages.

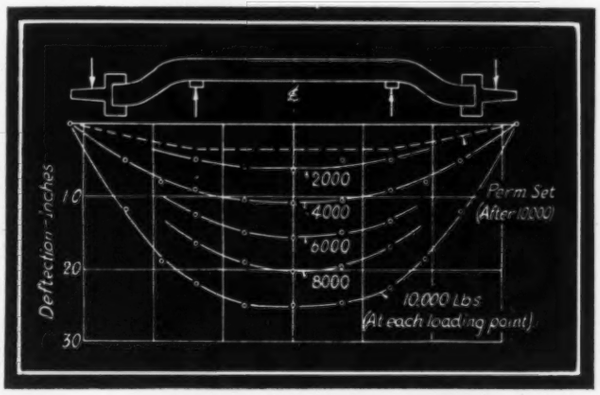
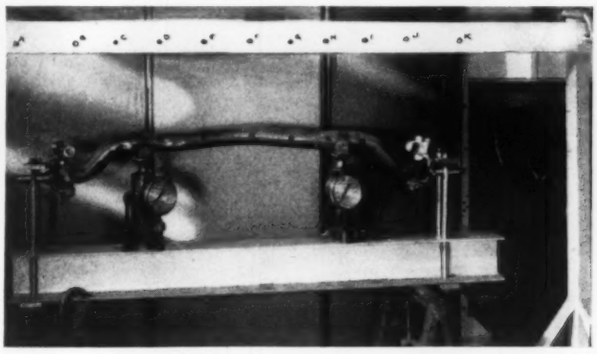


Fig. 7—Measurements of deflections by trammels provide the data for plotting the deflection curves of test specimens



To realize the full value from the test it is necessary that the data be prepared in useful and permanent report form. The ultimate strength can be reported directly and the failure described. Strain gage readings are direct and are correlated with test loads and reported as read. The deflection data must be interpreted, the usual method being by plotting. Two types of plotted deflection curves are common: (1) Load vs. Deflection (stress-strain) and (2) Location vs. Deflection.

Load vs. Deflection—In some instances deflection reading differences can be plotted directly, but in others the readings must be corrected by other readings that give the movement of supports or other reference points. Internal measurements (measurements between two points on the specimen) are plotted directly. The values are plotted with load as ordinate and deflection as abscissa to give the standard stress-strain form. An example is illustrated in the blueprint of *Fig.* 6. For a simple structure, each curve may be expected to be of the form *A*. Where bolted joints or thin metal constitute a part of the specimen, initial slip or internal stress may give a curve as *B*. Unless the definite reason for the large increment is known and has some specific significance, it is considered proper to transpose the curve the distance *y*, and *B* becomes identical to and is reported as *A*.

Important to Interpret Curves Correctly

For complex indeterminate structures and thin metal structures, many of the stress-strain curves may be very irregular, such as *C*. This curve shows that some yield has occurred at low loads but, due to load redistribution occasioned by the yield, the structure has recovered and the curve shows a steeper line terminating in the final yield and ultimate strength. Often it will be found that a subsequent test plots along the dotted line *C'* and a normal curve results. It is necessary to determine whether this initial readjustment is of importance and not to be exceeded in service necessitating the establishing of a low strength; or whether this initial yield and the corresponding distortion are not important to the proper function of the part and only the final yield and ultimate are the strength criteria.

Permanent set measurements may be plotted along the horizontal base line and connected to the curve at the corresponding load-deflection points. For the usual simple specimen these connecting lines will be parallel to the straight part of the primary curve and will serve as a check on the accuracy of the slope of this line.

Angular Deflection Measured in Degrees

In tests where torsion is the primary loading, the deflections can be reduced to angular deflections in degrees and minutes; these will have more significance than plotting of the readings themselves. The deflection (horizontal) scale is then given in degrees.

Location vs. Deflection—Where deflections for a particular load are plotted against their location on the test part, the resulting curve is the deflection form of the specimen. A series of measurements, perpendicular to a member and taken at intervals along its length, provide data for such a curve as shown in *Fig.* 7. A sketch of the specimen completes the curve sheet and makes it more easily understood. Internal measurements (between points on the specimen) can be used to establish the distorted form of a specimen. In most cases, the distortion scale must be magnified over the linear scale of the specimen to make the

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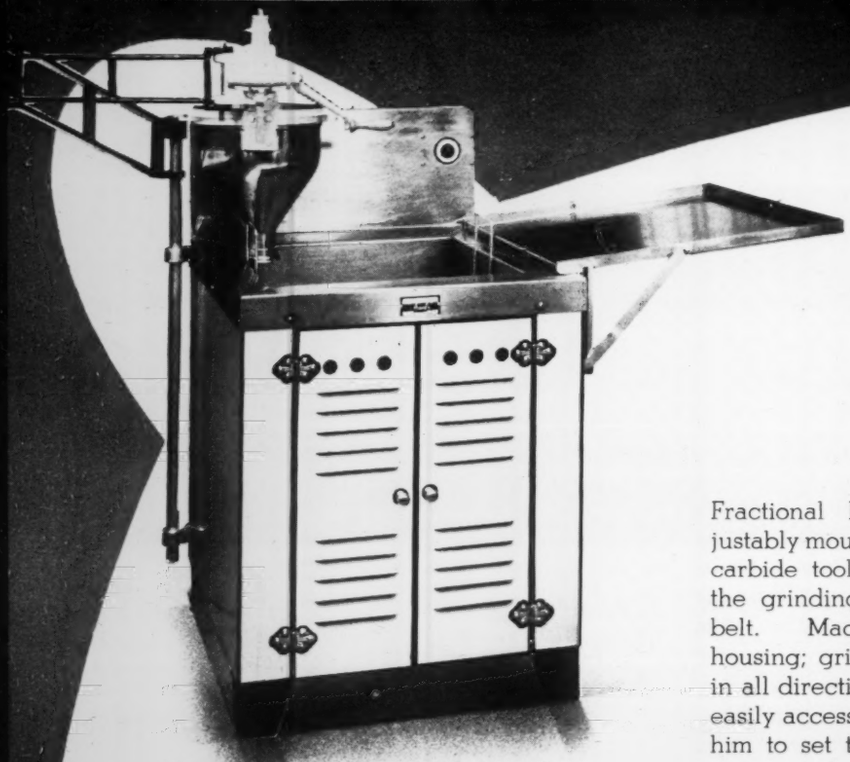
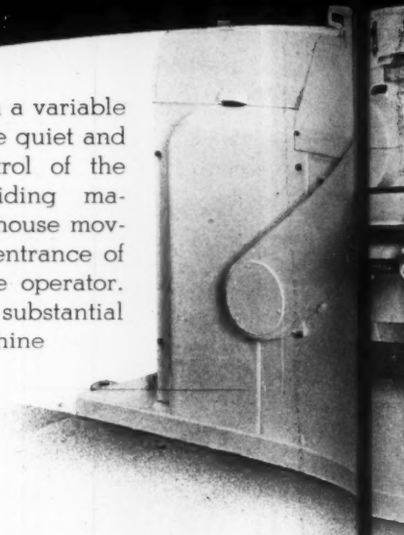
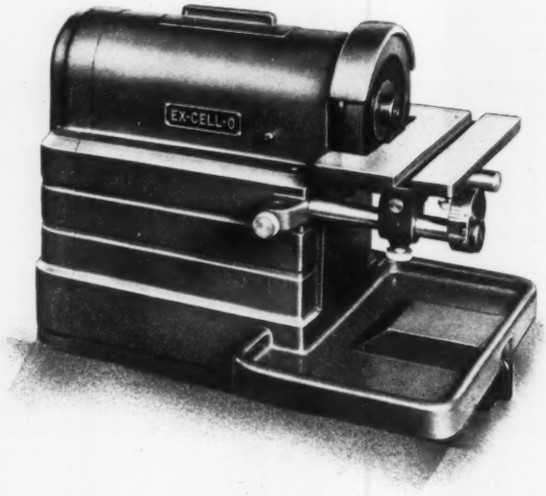


V-belts driving through a variable speed transmission give quiet and adjustable speed control of the Dutchess dough dividing machine, right. Guards house moving parts, preventing entrance of dirt and protecting the operator. Cast-iron base gives substantial support to machine



Fractional horsepower motor, adjustably mounted in base of Ex-Cell-O carbide tool grinder, below, drives the grinding spindle through a V-belt. Machine has nicely-styled housing; grinding wheel is shielded in all directions for protection. Dial, easily accessible to operator, enables him to set table angle quickly and accurately

Finished in either stainless steel or porcelain enamel, the new Anets tube fryer, above, is attractive as well as efficient. Thermostat for gas burner control holds fat temperature to exact degree set on dial. Small utility crane for doughnut machine allows device to be moved and set at any height



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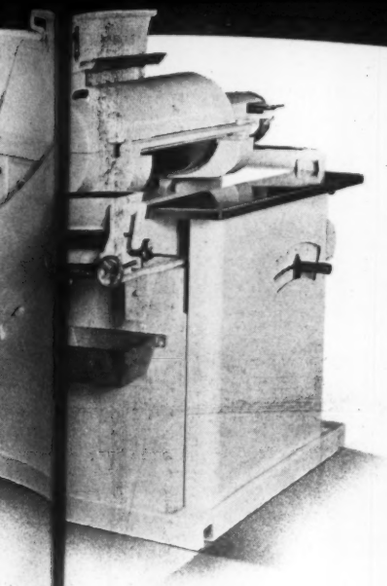
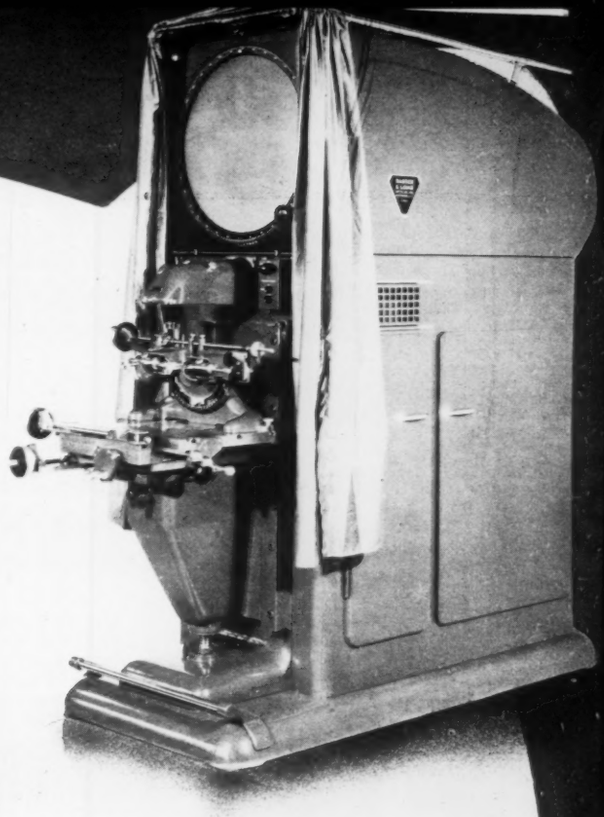
Constructed on a Caterpillar tractor, the Trackson power-control pipe laying winch, below, illustrates efficiency of small compact unit. Main frame of crane is all-welded; coil spring bumper prevents overthrow of boom in raising. Special transmission gives a choice of three speeds in either direction on both drums

Advanced streamlining for clean cut appearance and elimination of projecting parts is ably accomplished in the new Corona silent typewriter, above. In addition to improving appearance, radical styling gives more finger room for top row of keys. Smooth flowing lines substantiate sturdier construction of entire machine



Structural and heavy sheet steel are used in the construction of the Bausch & Lomb contour measuring projector, right. Precision, usually found only in microscopes and similar instruments, is built into this machine giving a high degree of measurement accuracy. Light source of projector is enclosed in cabinet, allowing a powerful light without interfering with operator



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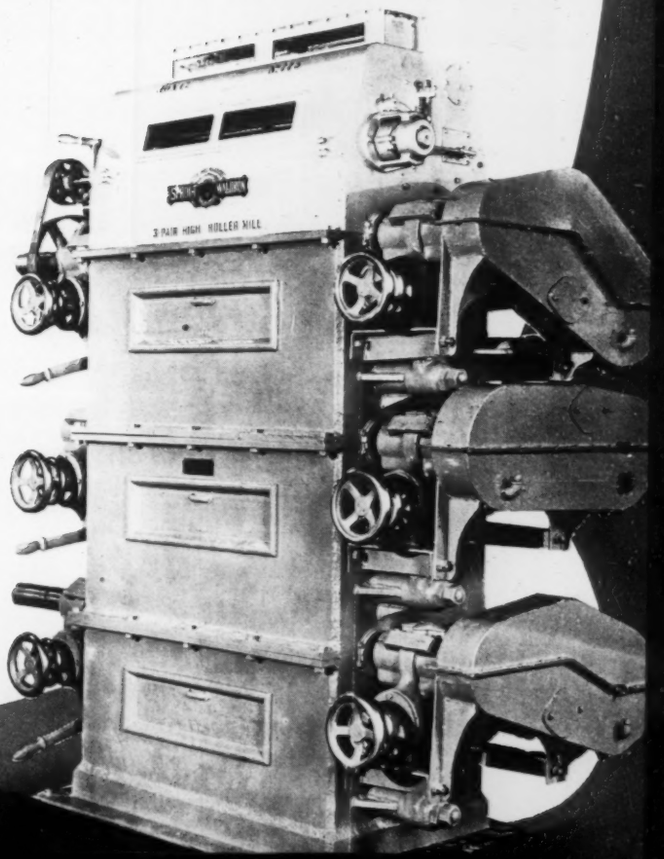
Seven-tube Crosley receiver, above, is equipped with five pushbuttons for tuning, and has separate bands for local and foreign broadcast. Plastic tuning dial is edge-lighted for convenience. Walnut finish cabinet is modernistic with sloping front and dial escutcheon designed to blend with vertical grain of cabinet

Welded steel frame provides ruggedness and neat appearance in the Sprout, Waldron "Monarch 10" roller mill, below, designed for cracking and reducing soy beans. Three pairs of chilled iron rollers are mounted one above the other for gradual reduction of the beans. Collar type oiling system is used for lubrication of roll journals



Built almost entirely of steel and providing 61 cubic feet carrying space, motorcycle trailer, left, built by Peninsular Steel Co., is mounted on cantilever springs, riding on a tubular steel axle. Weighing only 390 pounds, it has mechanical brakes, lock and tail light

Reorganization of Design Departments Should Not Be Delayed!

WAR clouds are gathering over Europe as this is written! Pessimism has no place in the scheme of things, but it would be futile not to recognize that the situation is more ominous than at any time since the period immediately preceding the last World war. Several events now taking place parallel those that occurred then, and the result of a false move at this time is a foregone conclusion. And it is also a foregone conclusion that with the current inter-relationship which exists between the major powers, this country would not be able to remain in isolated seclusion—at least not for long.

What of engineering departments, the chief engineer, the designer? There's hardly a machinery manufacturing company that would not be directly or indirectly engaged in producing war supplies or machines for making them in the event of hostilities. Many men obviously would enroll in fighting units, but for those who necessarily must stay behind the time also seems to have come to be prepared—to set the house in order so that it can function at the highest possible efficiency under any contingency.

Every chief engineer or design executive in charge of an engineering department could point to a dozen, maybe a hundred, things he would like to have done to increase the tempo of his department and the smooth flow of layout, development and operations through it. Obsolete equipment could well be replaced after having served its purpose as "good enough" during the depression; standards books containing frayed pages and old data could be revised; and new systems and policies could be set up that have been postponed only on account of the low business cycle through which we have passed.

All of this is based on the eventuality of war. But assume the clouds roll by and we run into a period of settled peace. The whole country is due for a busy time anyway, and there are strong indications that it is coming. It must—soon—so there's everything to gain and nothing to lose in adopting new policies and new equipment, and in making additions to personnel, while the time is still ripe.

Time and money spent now may return thousand-fold dividends—it's well worth the gamble both from a humanitarian and an economic standpoint!

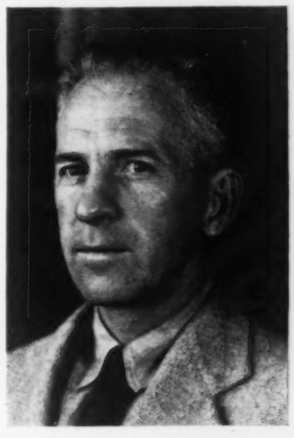
Men of Machines

R. D. SCHOTT

WELL known for his outstanding work in the pump industry, R. D. Schott has been appointed chief engineer of Pomona Pump Co. His previous experience included two years' service with Virginia Shipbuilding Co., and eighteen years with Bethlehem Ship Building Corp., in hydraulic and marine engineering design as related to ship propulsion. Mr. Schott's success in research and design of ship propellers and auxiliaries has been carried over into the pump field.

He is credited with having embodied further improvements in water-lubricated turbine pumps as well as developing low-lift pumps for capacities from 1000 to 100,000 gallons per minute. The largest municipal water systems and drainage projects are now using low-lift pumps of propeller or modified propeller design.

• • •



E. W. SCHELLENTRAGER

IN RECOGNITION of his ability as an executive and his engineering training and background, Atlas Car & Mfg. Co., Cleveland, has elected E. W. Schellentrager as vice president in charge of design, production and sales. Mr. Schellentrager was formerly chief engineer, to which capacity he had been appointed after his association with the company for only two years.

Born in Cleveland, he has centered all his activities there. He is well known in transportation circles and among industries served by the company, builders of electrically-operated weighing cars, special cars for industrial applications, as well as trolley, storage battery and diesel-electric locomotives for mining and industrial service.

• • •

R. G. WYLD

APPOINTMENT of R. G. Wyld as vice president in charge of engineering at Airtemp Inc., air conditioning subsidiary of Chrysler Corp., Dayton, O., was announced recently.

Mr. Wyld, who is a 1924 mechanical engineering graduate of Massachusetts Institute of Technology, has been connected with Airtemp since 1935 when he began as development engineer on air conditioning equipment at the company's old Detroit plant. In August 1936 he became executive engineer at the company's new plant at Dayton, O., to which it had moved in June of that year. He remained in this capacity until his present appointment.

His previous experience before becoming associated with Airtemp included that of development engineer on air conditioning equipment for

York Ice Machinery Corp. Prior to this he was connected with the De La Vergne Machine Co., of New York, devoting his time to engineering design, erection and servicing of refrigerating plants, ice plants, cold storage, etc. In this position he continued until 1934 when he joined York.

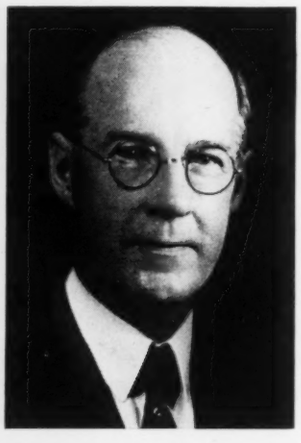
♦ ♦ ♦

A. H. GAESS, veteran designer of automatic metal fabricating machinery, and well known engineer and cold forging specialist, of Waterbury, Conn., is now executive sales representative for B-W Mfg. Co., Detroit.

♦ ♦ ♦

KENNETH H. DONALDSON, who for the past few months has been acting as temporary head of the department of metallurgical engineering, has been appointed head of this department at Case School of Applied Science. Professor Donaldson took over the duties from Prof. Herbert M. Boylston, who was granted leave of absence due to ill health.

CORRECTION — In the Men of Machines section of the August issue the photographs of William R. Woodside and Alexander G. Christie were inadvertently transposed. MACHINE DESIGN regrets the error and corrects it herewith.



Prof. A. G. Christie

Professor Alexander G. Christie is the nominee for the office of president of the American Society of Mechanical Engineers, and for the past eighteen years has been professor of mechanical engineering at Johns Hopkins university. William Park Woodside, vice president in charge of research, Climax Molybdenum Co., has been made president of the American Society for Metals in which society he has been active since its organization.

Prof. W. P. Woodside

C. V. HAYNES and JAMES K. PEACOCK, of Hoffman Specialty Co., Waterbury, Conn., have been elected life members of American Society of Heating and Ventilating Engineers, both having been members for many years. Mr. Haynes served as president of the society in 1934.

♦ ♦ ♦

KARL M. YOST has joined the staff of the Wagner Electric Brake Mfg. Co., as consulting engineer. Mr. Yost was formerly engineer in charge of the truck and bus brake division of Bendix Products Corp.

♦ ♦ ♦

EARL H. SMITH, assistant chief engineer of the Packard Motor Car Co., has assumed the duties vacated by Edwin H. Johnson, who recently joined the Crane Co.

♦ ♦ ♦

ROBERT H. HEYER has been chosen winner for 1938 of the Charles B. Dudley medal which commemorates the name of the first president of the American Society for Testing Materials and is awarded to the author or authors of outstanding papers. Mr. Heyer is junior metallurgist, Research Laboratories, The American Rolling Mill Co.

Obituaries

EVERETT WORTHINGTON, industrial designer, died recently at the age of 47, of a heart attack. Mr. Worthington was head of the firm Everett Worthington Inc., New York, and he had done designing for almost every branch of industry but aviation.

♦ ♦ ♦

LEWIS E. CURTIS, consulting engineer and inventor of the Curtis diamond mesh expanded metal rotary lath machine, died recently at the age of 74. He was consulting engineer for the past ten years, during which time he designed and supervised the building of machines for the metal lath industry, and held many patents covering machine design and the manufacture of expanded metal.

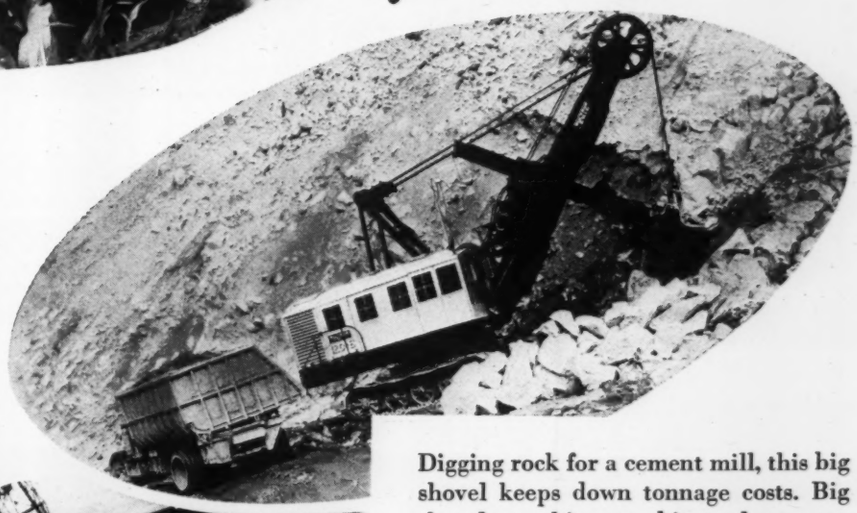
♦ ♦ ♦

WILLIAM HARVEY MUZZY, 66, patent lawyer and inventor, died on August 13 at Montclair, N. J. His early connections were those of patent counsel and manager of inventions as well as a member of the board of directors of National Cash Register Co., Dayton, O., and research engineer with Stewart-Warner Speedometer Corp., Chicago. He then joined a Washington firm of patent attorneys. Mr. Muzzy contributed to the development of the cash register and was credited with developing and receiving patents for 70 machines in use in the cash register industry. He has also invented numerous automotive devices.

Plowing Corn...

Opening new markets for farm tractors, Allis-Chalmers designed this new Model B. With 9 HP drawbar pull, this tractor offers mobile, economical power for many industrial uses. Despite the moderate cost of this tractor, more than a dozen highly stressed parts are forged from long-wearing Nickel alloy steels.

...Digging Rocks



Digging rock for a cement mill, this big shovel keeps down tonnage costs. Big shovels, working at a big-yardage pace, need the extra strength and wear resistance of Nickel alloy steels. Bucyrus-Erie engineers developed a special Nickel alloy steel, similar to SAE 3135, and special heat treatments to achieve higher physical properties.

...or Damming Rivers

Grand Coulee, three times bigger than Boulder Dam, is being built with hoists which speed materials 550 feet aloft. Hoisting machinery is safeguarded by the extra strength of Nickel alloy steels. Paradox gates which plug the Columbia River, hold raging water and resist abrading silt, are made of Nickel alloy steels with tensile strengths from 80,000 to 110,000 p.s.i.

Hard jobs Call for Toughness

ALLOY NICKEL STEELS

Your consultation regarding the uses of Nickel is invited.

THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N.Y.

NOTEWORTHY PATENTS

THE invention shown in *Fig.* 1, on which patent No. 2,118,236 has been granted to Francis E. Schwentler of St. Louis, assignor to the American Brake Co., relates to brake rigging for use on railway car trucks. It has to do particularly with that type employing a brake shoe which is moved into and out of engagement with a wheel by means of levers and rods operated by a cylinder, and in connection with which a "slack adjuster" is used. The object of the patented design is—among other things—to provide a structure which can be applied to or removed from the car truck as a unit.

The unit comprises a brake cylinder closed at one end by a pressure head preferably integral with the cylinder and at the opposite end by a nonpressure head secured to the body in the conventional way. The piston slides in the bore with a pressure chamber at one side and a non-pressure chamber at the other. A push rod is secured to the non-pressure side of the piston and extends through a hole in the non-pressure head. It is surrounded by a conical, coiled release spring designed to require minimum space. A crosshead is secured to the outer end of the push rod.

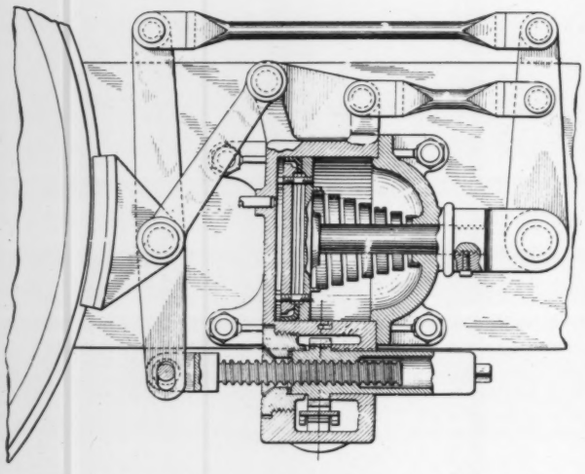


Fig. 1—*Self-adjusting railway brake mechanism is designed as compact unit, with cylinder as basis*

A live brake lever is pivoted to the cylinder body by means of a pull rod having one end connected to this live lever by a pin and the other connected by a pin to a lug on the cylinder body. One end of this lever is pivoted to the crosshead while its other end is pivoted to one end of a push rod.

A dead brake lever is located at the end of the cylinder opposite the live brake lever. This has one end pivoted to the push rod and the other end connected to a slack adjuster crosshead by a pin in a slot. Just below its center the dead brake lever is connected to a brake head which carries the brake shoe. A pair of brake hangers extending from this brake head to a lug integral with the cylinder body keep the brake shoe in proper location in regard to the wheel.

The slack adjuster crosshead is fastened to a screw which passes through a ratchet-operated adjusting nut mounted in a chamber below the brake cylinder. As can be seen in the diagram, the right hand portion of the nut is extended in the form of a protecting sleeve for the screw and a wrench grip.

Located transversely to the screw is a small piston with a stem bridging the periphery of the ratchet wheel on the nut and terminating in a follower, against which bears a coiled spring. To the right of the follower is mounted a spring-supported pawl which engages the teeth of the ratchet wheel on the back stroke of the small piston. The main cylinder and this small cylinder are connected by a cored passage which is uncovered only when the piston in the brake cylinder travels beyond a predetermined amount.

The result is that when this happens the small cylinder is energized by air flowing from the large cylinder, thus pushing the adjusting pawl to the left. On its back stroke under the influence of the return spring, the pawl engages a ratchet tooth and gives the adjusting nut a partial turn. This action will be repeated until the slack has been taken up by the screw to the point where normal travel of the brake piston is restored.

Preloading Without Distortion

DONALD H. MONTGOMERY of Berlin, Conn., is the inventor of the ball bearing spindle mounting depicted by *Fig.* 2. His patent, which is No. 2,111,869, has been assigned to the New Britain Machine Co. The principal object of this invention is to provide a

LIKE AN EXTRA INNING BALL GAME

DUMORE GIVES YOU MORE FOR YOUR MONEY

★

SPECIFICATIONS
TYPE KLA MOTOR

Series (Universal) 0-60 cycles; HP range, 1/7—1/20; full load speeds 106-1400 RPM; amperes, 1.83; watts input, 185; duty, continuous; temperature rise, 40° C; method of cooling, internal fan; bearings, composition bronze; housing cast iron; finish, black crinkle enamel; weight 7 lbs., 15 ounces.

DUMORE
Silver ANNIVERSARY
1913-1938

Joe DiMaggio eludes catcher Harry Danning's desperate stab with the ball and the Yanks seal the Giant's doom in the 1937 world's series. Acme Photo

● From outward appearance most motors look pretty much alike. But time and wear eventually show there's a mighty big difference in the way they are made. If you are particular about the motor that powers your product . . . if you want a unit with unfailing ability to deliver smooth, steady, two-fisted power . . . that will keep right on purring on grueling grinds after others "let go" . . . that takes with equal ease loads that are steady or with incessant starts and stops—if that's the sort of motor you're seeking you'll never be really satisfied with anything short of a Dumore.

Hasty, slipshod "mass" methods are taboo on the Dumore assembly line. Each unit embodies the most exacting practices, perfected by 25 years of research and experience. (1) Armatures dynamically balanced to *eliminate vibration,* (2) commutator leads swaged by special Dumore process to assure 100% *electrical contact,* (3) commutators ground concentric with bearings for *longer brush life,* (4) armature windings expanded then *sealed,* to *prevent centrifugal "breathing",* (5) motors inspected 5 *times* in manufacture; run-in to *seat brushes properly.*

Start now to get more power hours for *your* money. Adopt Dumore universal (AC-DC) motors as your power units. Available in 1/500th to 2/3 h. p. . . . . 0 to 60 cycles. Call on Dumore engineers for counsel. Write today for facts and engineering service application blank.

THE DUMORE COMPANY • DEPT. 128-J • RACINE, WIS.

DUMORE MOTORS
FOR *Extra Power Hours*

• compensates for wear

These Diesel engines have used Laminum shims the past six years, for adjusting main and connecting rod bearings and journal caps. (Babbitt-tipped shims are specified, to maintain close oil and pressure seal.) "Adjustments should be made after about .003-inch wear," RATHBUN-JONES recommend, emphasizing the continuous precision-adjustment feature afforded by Laminum shims during machine life. They praise, too, the ease of handling. Write for Laminum sample.

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1079

LAMINUM
Precision adjustment SHIMS

spindle mounting for multiple spindle automatic screw machines, with preloading so arranged that there will be practically no axial or radial movement of the spindle during operation, and without having heavy preloading in any way detrimental to the bearing. At the same time uniform expansion of the bearing due to load or high temperature is provided for.

In the design shown each bore in the spindle carrier has a shoulder at the rear. The spindles carry spaced ball bearings. One inner ring is mounted on the spindle and abuts the shoulder on the spindle at the front. The outer ring fits within the bore and the balls space the rings apart. Toward the rear of the spindle there is a second ball bearing whose inner ring fits the spindle and whose outer ring fits within the bore and abuts the shoulder therein.

Interposed between the outer rings is a spacer sleeve and between the inner rings is another spacer sleeve. The inner one is slightly shorter than the outer one—the amount depending on the degree of preloading desired.

When assembled there is a spacer ring surrounding

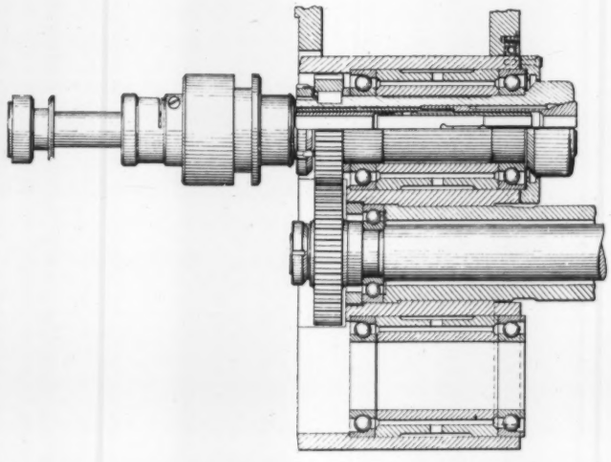


Fig. 2—Disk and roller variable transmission avoids vibration by use of floating and spring members

the spindle, this being interposed between the inner ring and the drive gear for the spindle. The spindle is threaded for a nut which abuts the drive gear. When this nut is screwed up the inner rings are drawn toward each other. With the parts thus assembled and bearings merely held in place without preloading, the spindle is set into the bore. Then an end cap is screwed to the face of the spindle carrier. This cover plate forces the outer ring toward the rear. The nut on the spindle is then turned up, thus preloading the bearings to the extent allowed by shortness of the inner spacer sleeve.

During the preloading the outer ring of the bearings is actually expanded to some degree, and with it expands the wall of the bore surrounding it. To prevent the bearings from going out-of-round, the walls of the bores are made of uniform thickness around the

American Seamless Flexible Metal Tubing

...Industry's Super Tubing

THE ideal flexible connector for misaligned or moving parts... for isolating vibration... for the dependable conveyance under high pressure of air, water, oil, steam or fuel. That's *American Seamless*—all metal, with no joints, welds, laps, seams or packing of any kind. The toughest tubing you can buy!

Write us about your connector problems. Our engineering department has a wealth of information on the use of *American Seamless* on all types of equipment.

Send for this free reference handbook on American Seamless Flexible Metal Tubing. Ask for Bulletin SS-3.

38335

American Metal Hose

ANACONDA
from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company

THESE FEATURES MEAN

High Efficiency Hydraulic Power

The new type patented construction of Hannifin high pressure hydraulic cylinders is not only stronger and simpler, but easier of application—ideally adapted to modern machine design. The flexible control and simplicity of hydraulic power movement are advantages made more practical by the high efficiency and extra ruggedness of the Hannifin design.

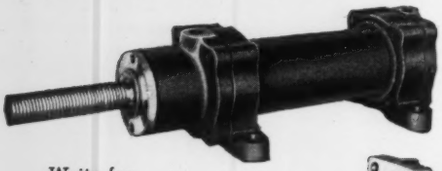
NO TIE RODS. This simpler design is stronger, and eliminates a source of leakage. End caps may be removed without collapse of other parts of the assembly.

UNIVERSAL CAPS. Either end cap may be positioned independently, so that inlet port is at top, bottom, or either side. Either cap may be moved without disturbing the cylinder mounting or other parts.

AIR VENT PLUGS. Each end cap has air vents on three sides. With the inlet port at either side or bottom, there is always an air vent plug at the top.

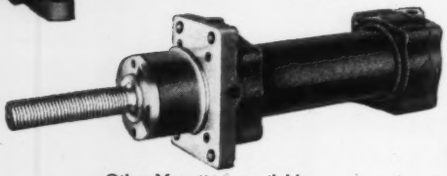
LEAK-PROOF. Special mirror finish honing produces a cylinder bore that is straight, round, perfectly smooth, and concentric with the end caps. A perfect piston seal is obtained.

MANY TYPES AND SIZES. Available in six standard mounting types, with small diameter piston rod, 2 to 1 differential piston rod, or double end piston rod, in all sizes, for working pressures up to 1000 and 1500 lbs./sq. in. Other types built to order, in any size, for any pressure.



Model CN

Model JN



Write for Bulletin 35-MD, with complete data.

Other Mountings available.

HANNIFIN MANUFACTURING COMPANY

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Engineers • Designers • Manufacturers

Pneumatic and Hydraulic Production Tool Equipment

HANNIFIN

HYDRAULIC CYLINDERS

bearings by coring out the body of the spindle carrier to form cylindrical shells integral with the carrier at the ends of the bores.

Rollers Work on Toric Disks

SHOWN in *Fig.* 3, as assembled with a reversing mechanism, is a variable speed power transmission covered by patent No. 2,112,763. The inventor of this device is John Leslie Cloudsley of London, England.

This transmission is described as being of toric disk and roller type. Co-axial outer disks with toric tracks on their opposing faces, face an intermediate disk having toric tracks on both sides. This intermediate disk receives power from the outer disks through two sets of interposed friction rollers which are swung on trunions to effect the desired variations of the speed ratio. The assembly is pressed together when in action by a torque-responsive pressure device of cam-and-ball type which is located in front of the disk nearest the right or power input end of the mechanism.

A feature of this invention consists in compensating for slight variations of the roller diameters by mounting one or both of the outer disks on part-spherical or convex surfaces so that slight rocking action is allowed. The intermediate disk is likewise

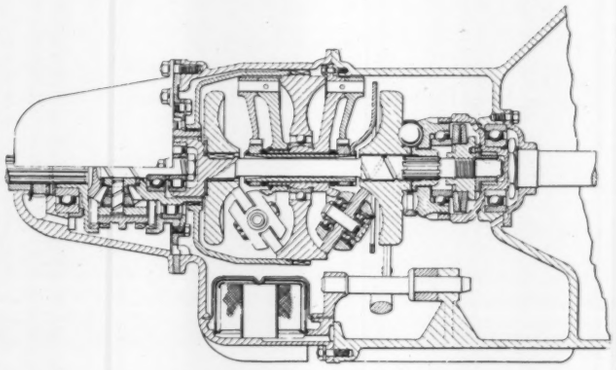


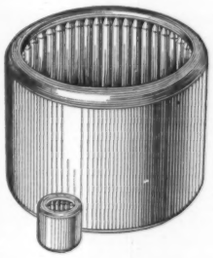
Fig. 3—This design insures that spindle bearings can be preloaded without danger of forcing them out-of-round

mounted in a similar manner. Spring washers are placed between the pressure-loading nut at the front end of the central shaft and the thrust race in front of the cam-and-ball pressure device. This is said to eliminate the tremors which otherwise are liable to occur during operation of a mechanism of this nature.

The inventor points out that the torque ring of the pressure device can well be made to serve not only as the front member of the cam-and-ball pressure device but also as the rear member of the thrust race and as the drive-receiving member of the front disk. Moreover, this ring and the companion ring of the thrust race are preferably formed to serve as a dual purpose race.

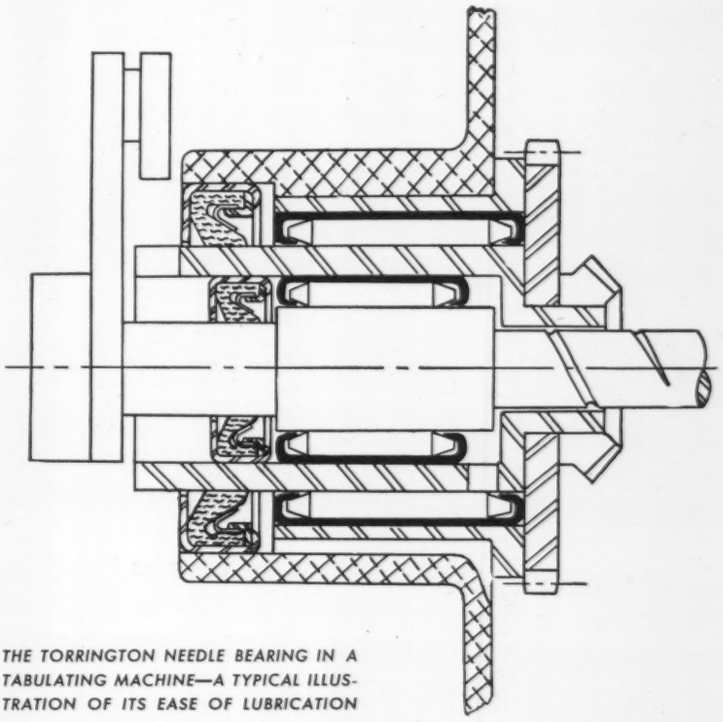
TORRINGTON NEEDLE BEARING

DESIGN AND SERVICE FEATURES



EASY LUBRICATION REDUCES SERVICE ATTENTION

Bearing Holds Ample Oil Supply



THE TORRINGTON NEEDLE BEARING IN A TABULATING MACHINE—A TYPICAL ILLUSTRATION OF ITS EASE OF LUBRICATION

THE SIMPLICITY of lubrication of the new Torrington Needle Bearing reduces the frequency with which maintenance attention is required. The hardened retaining shell for the needles is made with turned-in lips, which hold an ample supply of lubricant for long periods of operation. This is a special advantage where the equipment may receive service attention at infrequent intervals, as in the tabulating machine bearing illustrated.

Economical Construction

The low unit cost of the Needle Bearing permits the incorporation of anti-friction construction at surprisingly small expense. High radial load capacity—obtained by using a full complement of small diameter needles—allows the use of small bearings to take heavy loads.

The design of the bearing, with its small diameter in proportion to its length, simplifies the construction of housing needed, and effects marked economies in product manufacture. A simple bore of the proper diameter is all that is necessary for mounting the bearing. Further economies result from the ease with which the bearing can be assembled in the housing.

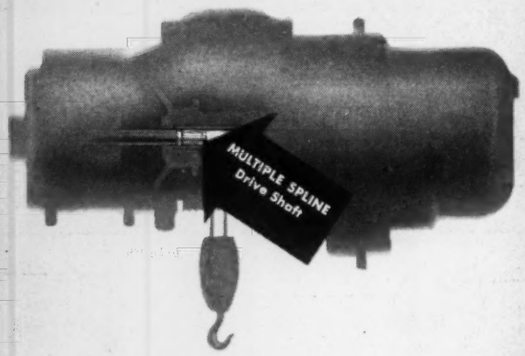
The Torrington Engineering Department will cooperate with manufacturers desiring to utilize these advantages in their products, and will assist in the laying out of bearing applications. Further information is given in the Torrington Needle Bearing Catalog, available on request. Write for Catalog No. 9.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Ball and Needle Bearings
Branch Offices in all Principal Cities

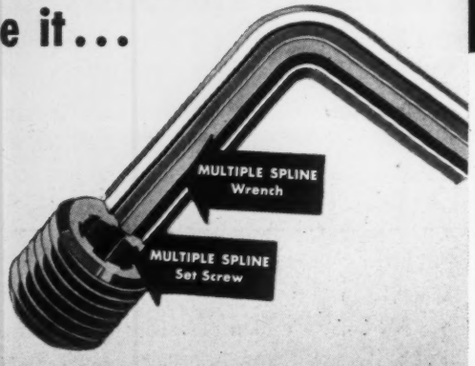
TORRINGTON
NEEDLE BEARING

MULTIPLE SPLINE...

ELECTRIC HOISTS use it



BRISTO SOCKET SCREWS use it...



. . . and for the same reason!

Of the proved multiple spline design, Bristo Socket Screws have the strength to take repeated set-ups without shearing, rounding out, splitting or stripping. For socket screws that won't flinch in any application, specify Bristos. Bulletin 83-5N gives full details about these nickel alloy steel Bristo Socket Screws. The Bristol Company, Mill Supply Division, Waterbury, Conn.

BRISTO

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Multiple Spline

SET AND CAP SCREWS

NEW Materials and Parts

Variable Speed Hydraulic Unit

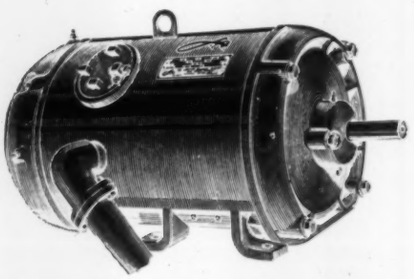
POSSESSING an extremely wide speed range, a new line of oil power variable speed transmissions has been placed on the market by The Sundstrand Machine Tool Co., Rockford, Ill. The transmissions develop high torque with smooth operation at slow speeds as well as higher speeds and provide high mechanical efficiency throughout the entire speed range. Another feature is instant reversal at high speeds on continuous duty which greatly increases

Hydraulic variable speed transmission develops high torque with smooth operation at slow speeds and provides high mechanical efficiency throughout speed range

the range of applications for hydraulic transmissions in both industrial and machine tool fields. The units are housed in a small compact case and consist of a variable displacement multiple piston type pump, a fluid motor also of the multiple piston type and an unusually simple control mechanism. The control may be either automatic or manually operated. In the illustration a Model 5HT unit, rated at 5 horsepower, is shown. It provides a speed range from 3 to 2400 R.P.M. Additional sizes are available from 2 to 10 horsepower.

Explosion-Proof Motors Offered

EXPLOSION-PROOF motors for use around combustible gases make up a new motor line of The Louis Allis Co., Milwaukee. One of the outstanding



Compact overall dimensions of explosion-proof motors make them interchangeable with standard types

features of the motors is their compact overall dimensions which make them interchangeable with alternating and direct current NEMA frame sizes. Especial-

NEW *neoprene* "BROOM" *sweeps lathe ways clean!*

Scoring of lathe beds is now no problem

A PROMINENT machine tool maker has designed a successful lathe wiper which will not pick up grit and other abrasive particles harmful to the lathe bed.

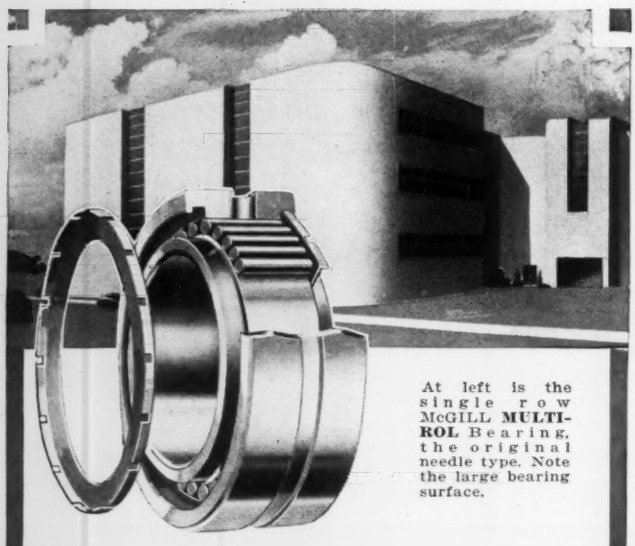
He installed "brooms" of molded *neoprene* under compression in metal housings, and thus insured close permanent contact with the ways.

Even on lathes equipped with force-feed lubrication systems, these close-fitting neoprene wipers leave the exposed bed way surface dry after the carriage has passed. And they sweep dirt and abrasive before them so thoroughly that there is no possibility of any foreign substance getting between the wearing surface of the carriage, or the tailstock base, and the bed. Thus frequent re-grinding of the lathe ways is eliminated, and the life of the machine is greatly prolonged. The neoprene wipers last indefinitely, because neoprene is not deteriorated by oil.

This is just another example of the way neoprene is being used to great advantage in more and more industries. Doesn't it suggest profitable applications of neoprene in your business too?

Write today for your subscription to the new, free, monthly "Neoprene Notebook," which gives you up-to-the-minute news about this remarkable material.

E. I. DU PONT DE NEMOURS & CO., INC.
RUBBER CHEMICALS DIVISION · WILMINGTON, DEL.



At left is the single row McGILL **MULTIROL** Bearing, the original needle type. Note the large bearing surface.

Use Today's Bearings for Today's Results

Better ways of doing things today are bringing better results and returns. In many places, better bearings are doing more than anything else in cutting costs and in improving production. These are McGILL *MULTIROL* Precision Bearings. Their great load capacity in limited space enables them to far outrun plain bearings and other anti-friction types in many uses — especially under sustained heavy or intermittent shock loads. Fewer bearing replacements are necessary. Machinery and equipment are more efficient. The bearings require much less oil and grease. Their small overall size often makes them interchangeable dimensionally with existing bronze or babbitt bearings which they replace. Many installations during the past eight years have demonstrated these facts conclusively.

McGILL
MULTIROL
The Precision Needle Bearings

McGILL **MULTIROL** Precision Bearings are made in many designs and sizes for use in practically every kind of equipment from bread slicing machines to locomotives. Stocked in standard sizes from ⅝ to 6-inch bore, single and double rows of rollers at low, volume production prices. Corrosion, heat resisting and other designs gladly engineered to individual requirements. Ask for Bulletin No. 37.

McGILL MANUFACTURING COMPANY
Bearing Division, 1450 N. Lafayette St.
VALPARAISO, INDIANA

ly important is their unusually low overall height. Rugged, heavily reinforced cast-iron and steel are used for construction and the air intake grille is made of cast aluminum. Sturdily designed radial type fan, located on the commutator end of motor, and cast from a special non-sparking high tensile aluminum alloy to prevent breakage, provides adequate cooling under all conditions. The new precision built motors will coolly deliver constant power under the most severe operating conditions and do it safely in atmospheres containing explosive dust or gases.

Pillow Blocks in New Housing

LINE of standard duty, roller bearing pillow blocks with a new type of welded steel housing construction has been announced by Shafer Bearing Corp., 35 East Wacker Drive, Chicago. The double row roller bearing used in these pillow blocks is furnished with extended inner race and two drive collars. The concave roller design provides generous capacity for radial, thrust, and combined radial-thrust loads, together with integral self-alignment. Automatic compensation is provided for misalignment or shaft deflection up to 1½ degrees each side of center. Pillow blocks are furnished with standard duty piston ring seals and pressure lubrication fittings. They are available in sizes from 1 7/16 to 8½ inches bore.

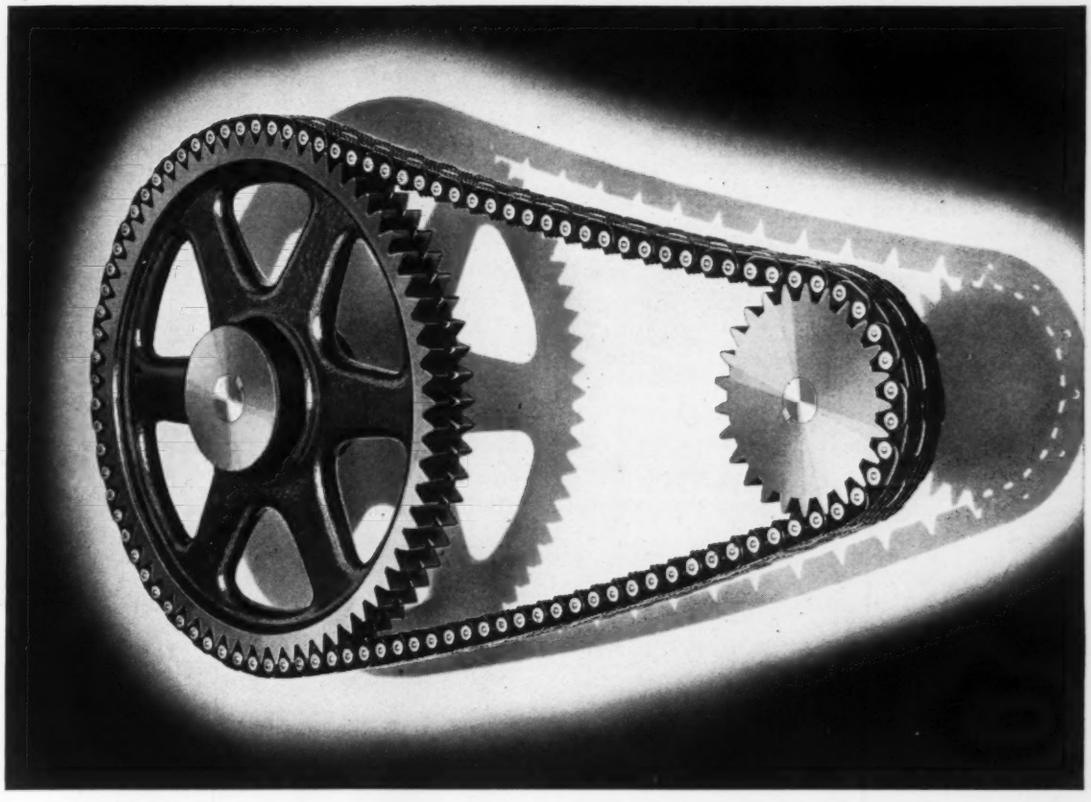
Concave roller design in pillow block provides generous capacity for radial, thrust and combined radial-thrust louds, and allows integral self-alignment

Plug Fuse Now Has Thermal Cut-Out

BUILT-IN thermal overload cut-out has been added to the plug fuse made by Trico Fuse Mfg. Co., Milwaukee. The new fuse, known as Trico-Matic, can be used in place of ordinary fuses on circuits having motor-driven machinery or appliances, such as refrigerators, oil burners, stokers, pumps, etc. The fuse fits the standard Edison base without the use or

Thermal cut-out in plug fuse holds circuit for starting and momentary overloads, yet gives protection on prolonged overloads

Still the best "Buy" in Power Transmission



● Buy your drives on the Service Basis and get double the life over ordinary "slipping" types of drives. Remember, too, Link-Belt Silverstreak Silent Chain Drives are frequently lower in first cost than V-belts or endless ropes.

Silent Chain Drives are positive—no slip—no wasted r. p. m's—operate on short centers—compact. Send for 96-page Data Book No. 125—it tells the whole story.

Link-Belt Company, Indianapolis, Chicago, Philadelphia, Atlanta, San Francisco, Toronto. Branch offices and distributors located in all principal cities.

Flexible as a Belt— More Efficient —*Positive as a Gear* than either

LINK-BELT
Silverstreak
SILENT CHAIN DRIVE

7433

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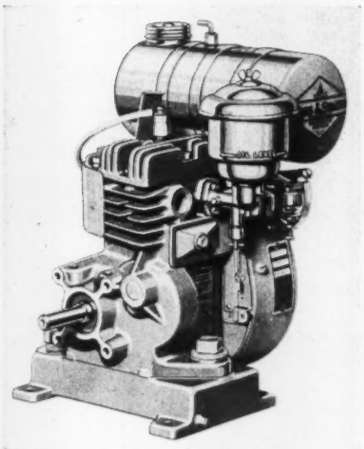
THE FREDERICK POST COMPANY
BOX 803 CHICAGO

INSTRUMENTS, EQUIPMENT and MATERIALS FOR THE ENGINEER and ARCHITECT. BLUE PRINT PAPERS and KINDRED SENSITIZED PRODUCTS

added expense of special adapters. The thermal cut-out holds starting and momentary overloads, yet gives safe and dependable protection on prolonged overloads, making overfusing unnecessary. Special features of the Trico-Matic include a color indicator for all popular sizes; all-porcelain and vent-proof top; a flag indicator when blown, and a flat releasing spring under copper link giving maximum travel in opening arc when blown.

Many Uses for Aircooled Engine

FOUR-CYCLE, air cooled engine, known as Model IBP, developing one horsepower at 3000 R.P.M. and .93 horsepower at 2600 R.P.M., has been announced by Briggs & Stratton Corp., Milwaukee. Piston displacement is 4.71 cubic inches and engine has a 2-inch stroke and bore of 1½ inches. Ignition is supplied by a specially designed dust and moisture-proof high tension flywheel magneto. Other standard equipment includes Silchrome exhaust valve with alloy steel inserted seat, molybdenum alloy valve guides, aluminum alloy cylinder head, adjustable pneumatic governor, drop forged crankshaft with ball bearing oil seal, air and gasoline filters, and crankcase drilled and tapped for mounting accessories. Engine is 14 inches high, 10½ inches wide and has a depth of 11 inches. Net weight is 38 pounds.



Ignition for small aircooled engine is supplied by specially designed dust and moistureproof high tension flywheel magneto

Numerous Uses for Split Ball Bearings

THREE types of split ball bearings have been introduced by Split Ballbearing Corp., Lebanon, N. H. Two radial types are available which conform in bore and outside dimensions with the English inch standards, and a thrust series conforming with the SAE standards. The bearings were developed especially for connecting rod, transmission shafts and similar applications where it is impossible or difficult to fit the conventional type of antifriction bearing. Unusual precision is maintained in the manufac-

Lanston Monotype Found Six Reasons for Using

TEXTOLITE

EACH ONE MEANT PRODUCT IMPROVEMENT OR ECONOMY

WHEN the Lanston Monotype Machine Company designed the new Barrett Figuring-Listing Machine, its engineers remembered General Electric's success in molding housings for other progressive manufacturers. Consequently, they called in a G-E Textolite specialist to help them apply Textolite to their machine with "protection to the precise mechanism" a prime factor.

But like many others who have investigated, carefully, the possibilities of Textolite, they found that in addition to complete protection it provided other advantages which helped make their product better. For instance, the lightness of Textolite reduced the weight of the machine, and its resilence deadened the sound of the mechanism. Then, too, no machining of the Textolite housings was necessary, as they were shipped from one of G.E.'s three modern molding plants to the Barrett factory, ready for assembly. And the black luster of the Textolite housing assured beauty and lasting finish.

The Barrett Figuring-Listing Machine is a rapid, efficient adding and listing machine, weighing only ten pounds and occupying a space of only one half the size of a business letterhead. The housing is molded of G-E Textolite

In addition to the finest types of molding materials available, you can rely on General Electric's fifty years of molding experience and its complete engineering, designing and manufacturing services to solve your molding problems and to show you ways of cutting production costs or improving the salability of your product — no matter how small, large, intricate or simple the part may be.

Write Section M-5, Plastics Department, General Electric Co., One Plastics Avenue, Pittsfield, Mass., for a copy of our new bulletin "One Plastics Avenue."

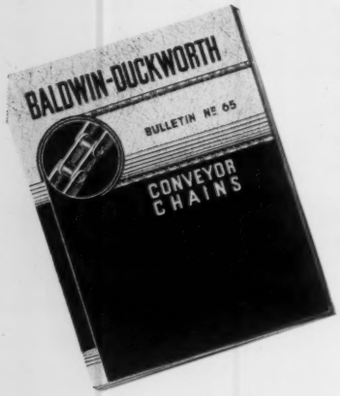
MOLDING PLANTS IN PITTSFIELD, MERIDEN, FORT WAYNE

GENERAL ELECTRIC

PD-45

IF you build any machines on this list . .

you specify some form of conveyor chain. The new B-D catalog may give you a new angle on the reliability and length of service which you should expect from such chain. It may also surprise you to learn how little it costs to get maximum performance.



It also carries many pages of engineering data which will simplify for you the selection of sizes, pitches, and attachments for varying conditions. Use the coupon.

Baldwin-Duckworth Chain Corporation

Springfield, Mass.

Factories at Springfield and Worcester, Mass.

BALDWIN DUCKWORTH

Baldwin-Duckworth Chain Corporation
Springfield, Mass.

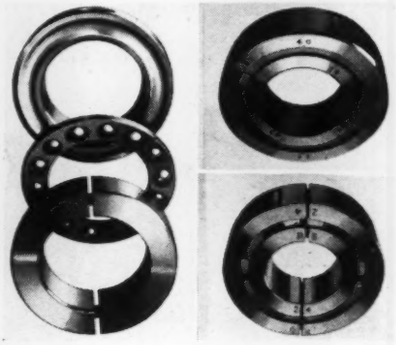
Send me, without obligation, Bulletin 65 of conveying chain

Signed .....

Company .....

City ..... **State** .....

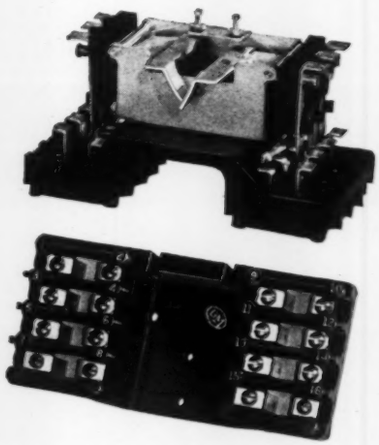
ture of these bearings, allowing them to be used for heavy loads and high-speed operation. The divisible type radial bearings are available from ¾ to 4 inches bore diameter; split thrust bearings may be obtained with bore diameters from ½ to 4 inches. Other sizes are available on special orders.



Precision of split antifriction bearings permits their use for heavy loads and high-speed operation. Two radial and one thrust type are available

Twin-Latch Relay Is Developed

NEW development in twin-latch relays is a standardized Type L unit just released by G-M Laboratories, Inc., 1731 Belmont, Chicago. The new relay carries loads up to 30 amperes, alternating current, and 10 amperes, direct current, but requires only 8 watts for operation. It is ideally suited for use in three-wire thermostatic control systems, or similar circuits. Type L relay consists of two coils and two hinged armatures, each of which carries a latch arm. The latch arms interlock, thereby mechanically holding one armature in the energized position until the other armature operates. The chassis is of molded Bakelite and has a sturdy ribbed construction. Overall size is 5⅜ by 2⅞ by 2⅞ inches.

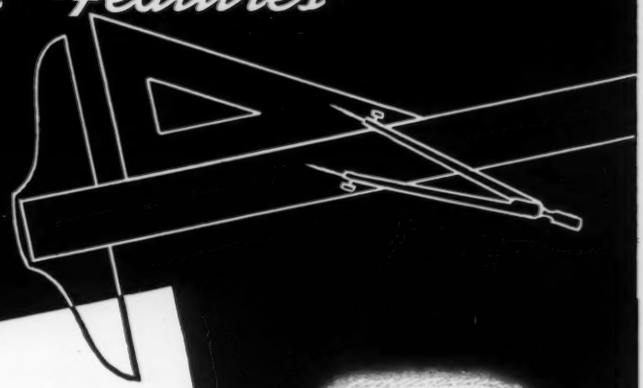


Relay has two coils and two hinged armatures, each carrying a latch arm, which interlock, thereby mechanically holding one armature in energized position until the other operates

Timer Is Easily Set

DEVELOPED particularly for convenient setting of timing intervals from two hours upward, at expiration of which a circuit is opened or closed, the

Check the Design Features of Wagner Motors That Are Most Important to You



✓ Efficiently Engineered

Wagner motors are carefully engineered with performance characteristics that are ideally suited for satisfactory operation of machinery and appliances. They are available in a wide range of types and sizes to fulfill the requirements of various types of applications.

✓ Compact Design

Wagner motors are accurately designed and compactly built without sacrificing sturdiness or efficiency.

✓ Sturdy Construction

Wagner motors are known for their strength and rigidity. The rugged, welded steel stators have well-insulated windings that are securely wedged in place. Special-alloy-steel shafts are designed to carry reasonable mechanical overloads.

✓ Quiet Operation

All Wagner rotors are dynamically balanced to insure freedom from vibration. Rotor slots are skewed and combined with careful electrical design to insure a motor with a minimum of magnetic noise.

✓ Long-Life

The life of motors depends upon the conditions of operation to which they are subjected and the care they receive. Wagner motors are so constructed that wear between moving parts is reduced to a minimum. In addition, all parts are liberally designed with high factors of safety.

✓ Completely Reliable

All motor parts and completed motors are carefully tested to meet exacting specifications according to the highest electric motor standards — an assurance to users that Wagner motors are reliable, free from defects, and will give satisfactory service.

MM238-2J

Single-Phase Motors

Repulsion-Start-Induction (See above)
—:—
Split-Phase
—:—
Repulsion-Induction
—:—
Capacitor Start
—:—
Capacitor
—:—
Double Capacitor
—:—
Shaded Pole
—:—
Gear-Motors

Polyphase Motors

Squirrel-Cage Motors (See above)
—:—
Slip-Ring
—:—
Self-Exciting Synchronous
—:—
Multi-Speed
—:—
High Torque Induction
—:—
Direct-Current Motors

Write Today
For Literature Describing
These Wagner Motors

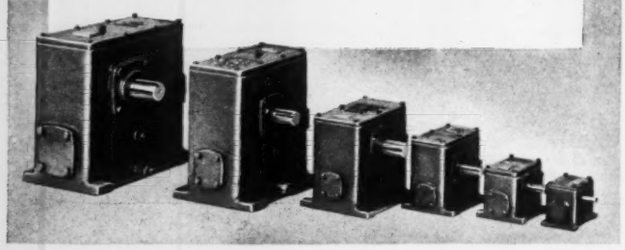
Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, U.S.A.

MOTORS TRANSFORMERS FANS BRAKES

SIX STEPS

TO LOWER POWER COSTS



D6	D5	D4	D3	D1	D00
11,000 inch lbs. output	6,000 inch lbs. output	1,000 inch lbs. output	400 inch lbs. output	200 inch lbs. output	100 inch lbs. output

• Six, compact, capable members comprise the Ohio Gear line of Double Speed Reducers. All are of the same, sturdy construction, with Timken bearings on the slow speed shaft and radial thrust bearings on the high speed shaft. All worm gears are of SAE 65 (British Gear) Bronze, and all worms are hardened and ground.

These boxes are offered in ratios of 100—200—300—400—600—800—900—1200—1600 to 1, with other ratios available. Nos. D5 and D6, newest additions to the line are offered in ratios up to 2400 and 3200 to 1.

Within these torque limits, this Ohio Gear line affords the widest range of ratios now obtainable. All boxes are carried in stock, ready for assembly and immediate delivery.

For practical, economical power transmission, investigate Ohio Gear. Complete catalog on request.

THE OHIO GEAR CO.

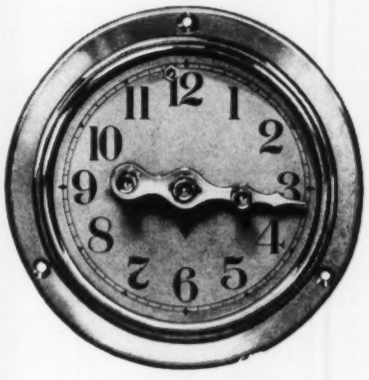
1338 E. 179th Street • Cleveland, Ohio

Representatives

*LOS ANGELES, CALIF. J. W. Minder Chain & Gear Co., 927 Santa Fe Avenue.
*SAN FRANCISCO, CALIF. Adam-Hill Co., 244-246 Ninth Street.
INDIANAPOLIS, IND. A. R. Young, 518 North Delaware Street.
LOUISVILLE, KY. Alfred Halliday, 330 Starks Building.
DETROIT, MICH. George P. Coulter, 322 Curtiss Building.
MINNEAPOLIS, MINN. W. H. Erskine, Box 72, Traffic Station.
BUFFALO, N. Y. F. E. Allen, Inc., 2665 Main Street.
NEW YORK CITY, N. Y. Patron Millwright & Transmission Co., 154-156 Grand Street.
NEW YORK CITY, N. Y. E. G. Long Co., 50 Church Street.
GRAND RAPIDS, MICH. W. H. Slaughter, 419 Oakdale St., S. E.
NEW ENGLAND. George G. Pragst, 260 Esten Ave., Pawtucket, R. I.
PITTSBURGH, PA. Industrial Sales & Engineering Co., Box 8606, Wilkinsburg, Pa.
SALT LAKE CITY, UTAH. A. O. Gates, 619-629 South Fifth West Street.
*Stocks carried.

OHIO GEARS

No. 82 series timer with clock mechanism has been placed on the market by Walser Automatic Timer Co., 420 Lexington avenue, New York. Unusual feature of the timer is a new type of escapement which makes possible the same simplicity of operation on 12-hour gearing as on a gearing of one minute to the cycle.



Winding of clock movement on timer is not required as the setting of pointer to the desired interval provides operating power, sets the switch circuit and starts timing mechanism, simultaneously

No winding of the clock movement is required, as the turning of the pointer to the interval desired provides the operating power, sets the switch circuit and starts the timing mechanism, simultaneously. Overall diameter of timer and mounting ring is 4¼ inches; actual dial diameter is 3 inches. Applications of this type of timer include radios, refrigerators, fans, blowers, air conditioners, linotype machines, coin meters, mixers, pumps, etc.

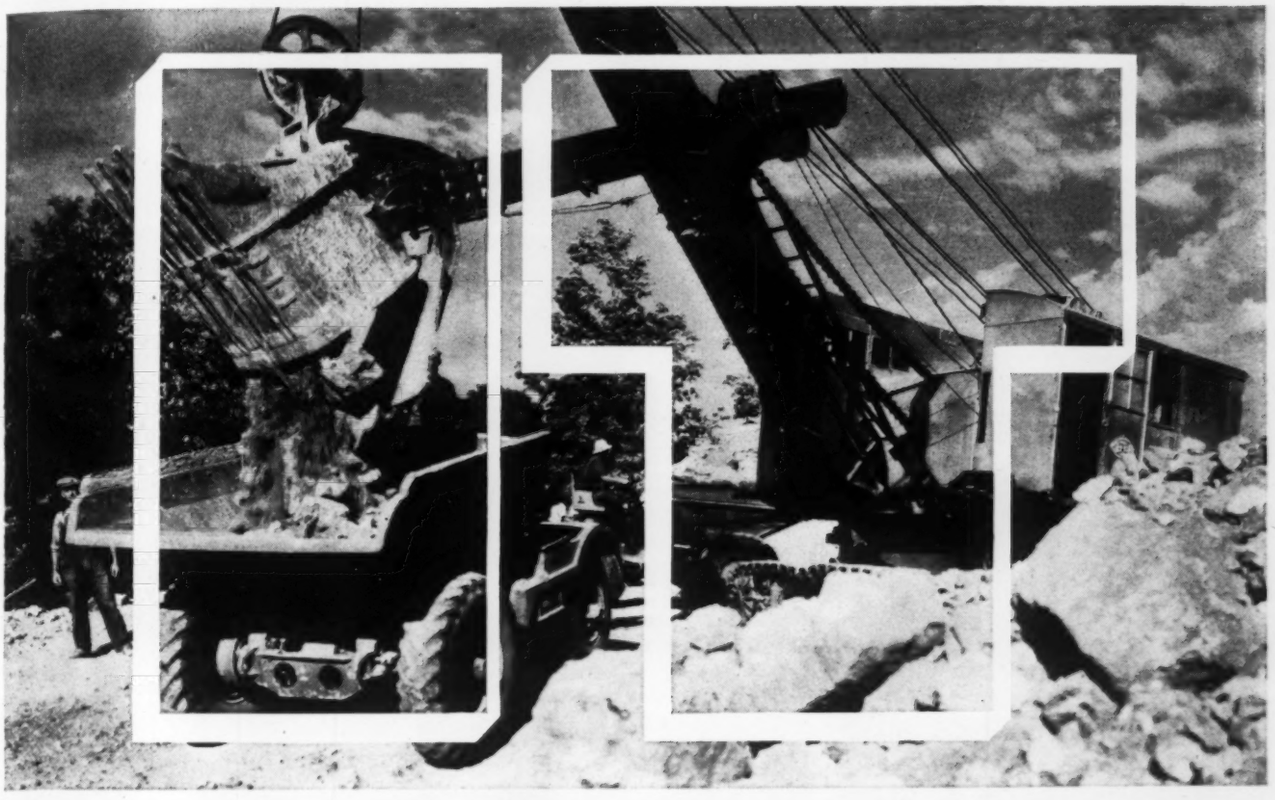
Pump Hose Resists Corrosion

GASOLINE pump hose, designed with a smooth inside to give a full, fast flow, to be light in weight, flexible and able to withstand crushing has been placed on the market by The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J. The Parantite pump hose, style R-W, has a non-swelling gasoline-proof synthetic tube which eliminates interior disintegration and also protects the hose body from the destructive action of gasoline. The hose is of rugged construction, having two plies of braided cotton cord and a spiral of hard steel wire, bound by rubber into a solid unit. It is statically grounded from coupling to coupling.

Rheostat Line Supplemented by New Model

"MODEL P" is a new 225-watt rheostat, announced by Ohmite Manufacturing Co., 4835 West Flournoy street, Chicago, filling in between the 150 and 300-watt units already made by the company. Time tested and perfected all-porcelain and metal type of construction is employed in the "Model P." Resistance wire is accurately wound on a solid porcelain core and is rigidly held in place. It is insulated and permanently protected by porcelain enamel. The

HOW TO HANDLE



IF *IT* IS DIGGING-MACHINE DESIGN

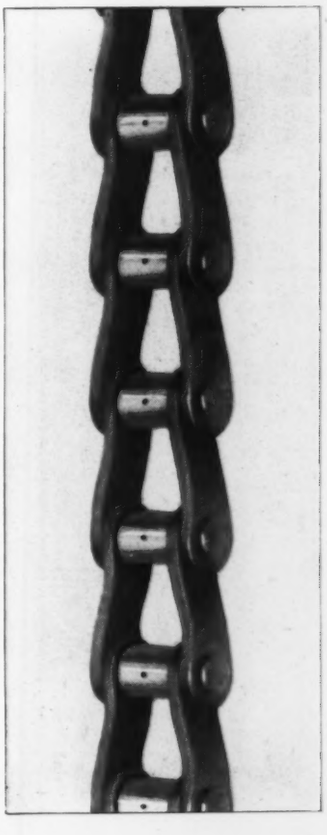
The first chain crowd ever put on a power shovel was Rex Chabelco Chain.

Again, one of the first chain drives ever put on a power shovel crawler was Rex Chabelco Chain. As the power shovel became still faster, lighter and more mobile, more and more Rex Chabelco Chain was employed.

The power shovel is by no means unique in the use of Rex Chabelco drives. The same tendency has characterized many other types of construction equipment.

There are many other drive methods that find a proper place in machine design, but where centers are fairly long—where positive and, at the same time, flexible and shock absorbing drives must be used—where drives must be left exposed—where dirt, grease and abrasion abound—check first on the possibilities of Rex Chabelco Chain.

Rex Engineers skilled in chain application are always available to assist you. Chain Belt Company, 1643 West Bruce Street, Milwaukee, Wisconsin.



DRIVE AND REX CONVEYOR CHAIN

CHAIN BELT COMPANY

OF MILWAUKEE

"Quick, WATSON, THE **Graphite Particles!"**

"No Grit - No Scratch - No Smudge" is not just an advertising punchline for A. W. Faber's "Castell" Drawing Pencils. It's a scientific statement of fact.

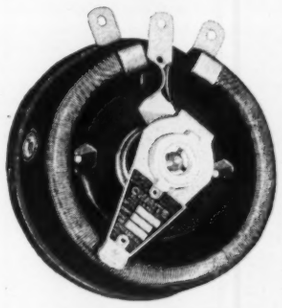
"Castell" graphite is milled by the exclusive microlette process, cleansed and purified by countless operations to give it a graphite purity of between 99.5% and 99.8%.

That's why we are eager for Watson to give "Castell" the most rigid test known. It will only prove what thousands of craftsmen know—that "Castell" has no hard spots, can not flake, scratch or crumble. And it costs only a few pennies more.

"CASTELL"
DRAWING PENCIL ★ 15c
IN THE METAL BOX
The highest priced drawing pencil sold in America.
MADE IN BAVARIA

A·W·FABER·Inc. NEWARK, N. J.

new rheostat provides practically stepless resistance variation and gives smooth, close control. Rheostats of this construction are now available in 25, 50, 100,

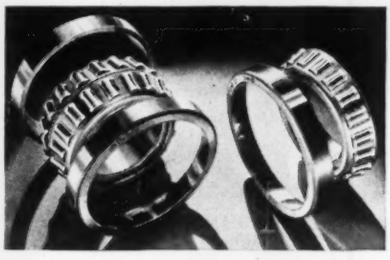


Porcelain enamel is used for insulation of resistance wire in small rheostat

150, 225, 300, 500 and 1000-watt models in a wide range of resistance values. They may be had in single or tandem assemblies.

New Distributor for Roller Bearings

SHAFER radial-thrust, single-row and double-row roller bearings in the naked or unmounted form are now being marketed by Link-Belt Co., 307 North Michigan avenue, Chicago. Features of this line of bearings include free rolling action with unimpaired loading capacity even in the presence of shaft mis-



Bearings of this type have free rolling action with unimpaired loading capacity even in the presence of shaft misalignment

alignment; thrust capacity is provided by the roller and raceway shapes and by the angular position of the curved rollers between curved races; radial or thrust or any combination of radial-thrust loads will be carried equally as well and on the same full contact area under all conditions of alignment. Bearings are in stock in a wide variety of types and sizes.

Rubber Wipers for Machine Surfaces

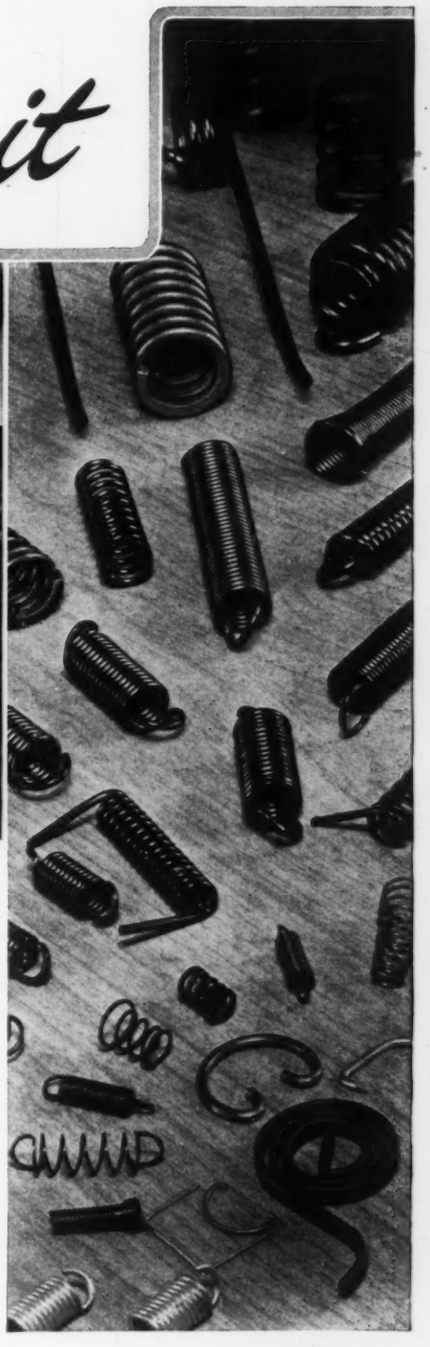
PARANITE oilproof synthetic rubber wipers for use on lathes, planers, grinding machines, turret lathes and other machine shop equipment have been developed by The Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J. Other types of wipers used on way surfaces to prevent metal chips and foreign substances from wearing these surfaces, often pick up metal particles which cause wear and scoring. Paranite wipers, in addition to being resistant to the effects of oil, acid or other liquids, will not

If the spring you need has never been made...

TELL us what the spring must do and we will provide you with American Quality Springs that will do the job the way you want it done. For if we do not already make a spring of the type you need, our engineers will design a spring that will answer your problems.

American Quality Springs can be depended upon to give the kind of service for which they are intended. They resist fatigue . . . hold their shape and give additional life to your product, because they have the quality behind them that has been developed in more than a century of experience in the manufacture of wire products. No matter what type of springs you need, we can supply them . . . for we produce every type and size of compression, extension, torsion and flat springs in common use.

Many manufacturers have found that a distinct improvement in their products has resulted from using American Quality Springs. And many manufacturers have discovered that our engineering department can be of real help in solving their unusual spring problems. Why not put it up to us? A letter or a telephone call will get immediate action.



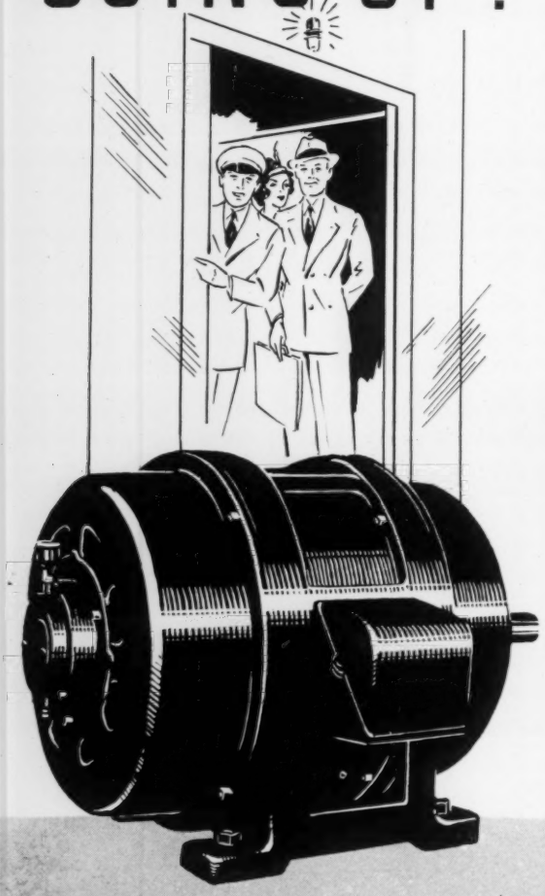
AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

GOING UP?



P&H HIGH EFFICIENCY ELECTRIC MOTORS

FOR ELEVATOR SERVICE

Of course, the electric motors used for the lifting and lowering of heavy loads, must be especially engineered for the purpose. First to recognize this need more than 50 years ago, P&H built the first electric motors specifically for hoisting service. And P&H has built them ever since. This long experience with electric motors for elevator, crane, and hoist service is available to your own organization. Our electrical engineers will gladly discuss your motor problems without cost or obligation. Write us. The Harnischfeger Corporation, 4556 W. National Avenue, Milwaukee, Wis.

Convertible slip-ring and squirrel-cage motors up to 250 h. p. capacity. Literature on request.

HARNISCHFEGER CORPORATION

MOTORS • HOISTS • WELDING ELECTRODES P&H ARC WELDERS • EXCAVATORS • ELECTRIC CRANES

absorb grit or abrasive material. They may be molded in sizes to suit the machines on which they are to be used.

Adjustable Sheave Developed

HAVING a range of pitch diameters varying from 2 to 3 inches and from 3 to 4 inches by merely removing the adjustable plate, reversing and again placing on hub, an adjustable texsteel sheave has been developed by The Texrope Division, Allis-Chalmers Manufacturing Co., Milwaukee. The outer plate in the position shown at left in illustration allows belts

By reversing one side of sheave, the pitch diameter is changed allowing belts to ride high or low as the case may be

to ride high and give a pitch diameter anywhere from 3 to 4 inches; the outer plate reversed, as shown at right, allows the V-belts to ride low and give a pitch diameter anywhere from 2 to 3 inches; the two together providing for a speed variation of 100 per cent. The sheave was developed in response to a demand for a unit that is low in cost and yet has a wide range of speed variation. It is especially suited to the heating and ventilating industry.

Bearing Metal Is Self-Lubricating

SELF-LUBRICATING bearing metal, combining lead and copper, described as a solidified emulsion of these two metals, has been introduced by Woodworkers' Tool Works, 223 South Jefferson street, Chicago. Known as "Oman" metal, it is actually a copper matte having its interstices filled with amorphous virgin lead. Bearings of Oman metal will not score easily and will support loads far in excess of normal capacity. The metal is easily machined and requires no cutting lubricant.

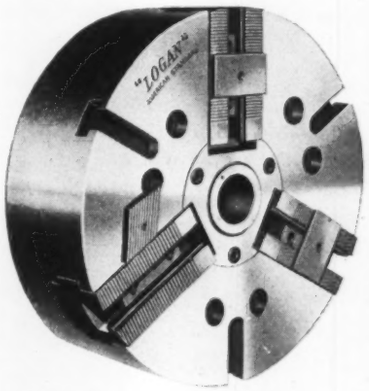
Light Chuck Is Power Operated

LINE of power operated chucks, designed to conform to the specifications of the American Standards association, and incorporating all the basic fea-

(*Continued on Page* 69)

(*Continued from Page* 66)

tures of the previous "Logan" chucks, has been developed by Logansport Machine, Inc., Logansport, Ind. Among the important features of the "Logan" line is the one-piece cast electric steel body used in all models. The chuck body is cored for light weight and correct



Positive lubrication of all working parts in chuck is provided by pressure fittings

balance. Positive lubrication through pressure fittings is provided to all working parts to insure long life and efficient operation. The new chucks mount directly on American Standard spindle noses, and the elimination of adapters offers more accurate concentricity, simple installation and reduced weight.

Lead-Bearing Steel Easily Machined

LEAD-BEARING open hearth steel, offering a combination of qualities that permit a high rate of production on automatic screw machines, has been developed by Bliss & Laughlin Inc., Harvey, Ill. The lead addition greatly increases the machinability of the steel without otherwise affecting its physical properties in any way. The steel machines with an ease equal to the high-sulphur grades of Bessemer steel, yet it retains the characteristics of open hearth screw stocks. It has sufficient ductility for cold forging operations, such as bending, swaging or broaching. The new lead-bearing steel is available in all standard SAE analyses and is produced in a full line of finished bars.

Flameproofing Liquid for Materials

LIQUID, called Fla-Munize, for rendering various surfaces flameproof has been developed by U. S. Flame Proofing Co., 4461 West Jefferson avenue, Detroit. For giving wood a protective coating which resists flame and retards fire, type X-1000 is recommended. It is inorganic, and thus non-poisonous and non-toxic. For interior use on wood construction, walls and canvas, X-2000 is used. Two coats are applied, and it is then sealed with any kind of paint, varnish or shellac. For all types of textiles, such as drapes,

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Hundreds of designing and operating engineers are wise to this superior oil seal. They are using the Garlock KLOZURE under severe conditions and find that it does everything we claim for it—resists oil and water, is unaffected by high temperatures, does not become soft and flabby in service and gives long, uniform performance.

The KLOZURE sealing ring is not leather, cork, felt or fibre. It is made from a compound developed by Garlock especially for oil seal service. This compound is non-porous, non-abrasive, tough and durable. Being inherently resilient, it does not require heavy spring loading.

SPLIT-KLOZURE

Dismantling of heavy machinery is unnecessary when installing the new Garlock SPLIT-KLOZURE which is applied around the shaft in the same manner as a packing ring. It is a time- and money-saver. Like the standard solid KLOZURE, the Garlock SPLIT-KLOZURE is furnished in a complete range of sizes.

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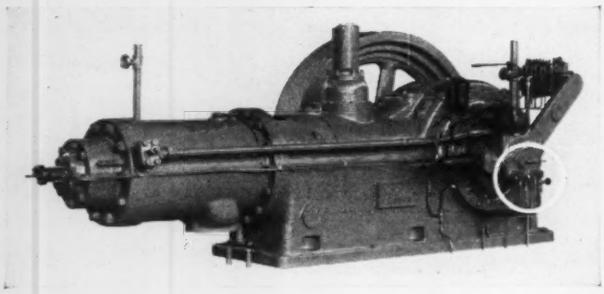

Viking Pumps are *Standard Equipment* on Most Diesel Engines . . .

Illustrated above is a Ball-Muncie, Type "7-H", 90 H.P. Diesel Engine, Viking equipped. Like the majority of Diesel engines manufactured today, this model includes Viking Rotary Pumps as standard equipment. Built directly into the engine, these three Vikings are used for pressure lubrication, auxiliary fuel injection and fuel supply. Write for Bulletin 2201-36 and check Viking's complete list of pumps for Diesel Engine Service

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rugs, linen, etc., the third flameproofing type, X-3000 is recommended. It does not cause a stiffening of the cloth or paper, nor cause the fabric to deteriorate. The liquid may be applied by spraying, immersion, or by sponging.

Meetings and Expositions

Sept. 12-16—

American Society of Mechanical Engineers. Applied mechanics and hydraulic division cooperating in International Congress of Applied Mechanics to be held at Massachusetts Institute of Technology, Cambridge, Mass. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

Sept. 15-17

American Foundrymen's association. Second fall technical conference to be held in Michigan Union building, Ann Arbor, Mich. R. E. Kennedy, 222 West Adams street, Chicago, is secretary.

Sept. 19-22—

American Transit association. Annual meeting and exhibition to be held at Atlantic City Auditorium, Atlantic City, N. J. G. C. Hecker, 292 Madison avenue, New York, is general secretary.

Sept. 19-23—

Seventh International Management congress. To be held in Washington. Nathaniel W. Barnes, 347 Madison avenue, New York, is executive secretary.

Sept. 27-30—

Association of Iron and Steel Engineers. Iron and steel exposition to be held at Public Auditorium, Cleveland. Further information may be obtained from headquarters, at Empire building, Pittsburgh.

Oct. 5-7—

American Society of Mechanical Engineers. Fall meeting to be held in Providence, R. I. C. E. Davies, 29 West Thirty-ninth street, New York, is secretary.

Oct. 6-7—

Society of Automotive Engineers. National fuels and lubricants meeting to be held at Hotel Mayo, Tulsa, Okla. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Oct. 8-15—

National Dairy association. Annual meeting and exposition to be held at Deshler-Wallick hotel, Columbus, O. Lloyd Burlingham, 308 West Washington, Chicago, is secretary.

Oct. 10-12—

American Gear Manufacturers association. Twenty-first semiannual meeting to be held at Skytop Lodge in the Pocono mountains of Pennsylvania. J. C. McQuiston, 602 Shields building, Wilkinsburg, Pa. is manager-secretary.

Oct. 13-15—

Society of Automotive Engineers. National Aircraft Production meeting to be held at Ambassador hotel, Los Angeles. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Oct. 14-15—

American Society of Tool Engineers Inc. Semiannual meeting to be held in Pittsburgh. Ford R. Lamb, 2567 West Grand boulevard, Detroit, is executive secretary.

Oct. 17-21—

American Society for Metals. National metal congress and exposition to be held at Convention Hall, Detroit. W. H. Eisenman, 7016 Euciid avenue, Cleveland, is secretary.

Oct. 17-21—

American Welding society. Annual meeting to be held in Detroit. M. M. Kelly, 33 West Thirty-ninth street, New York, is secretary.

Oct. 17-21—

Wire association. Annual meeting and exposition to be held at Detroit. Richard E. Brown, 17 East Forty-second street, New York, is secretary.

Oct. 17-21—

Wire Machinery Builders' association. Annual meeting and exposition to be held at Detroit. W. D. Pierson, Box 70, Waterbury, Conn., is secretary.

Oct. 17-22—

Dairy and Ice Cream Machinery and Supplies association. Dairy Industries exposition to be held at Public Auditorium, Cleveland. Roberts Everett, 232 Madison avenue, New York, is executive vice president.

Oct. 24-28—

National Electrical Manufacturers association. Annual meeting to be held at Palmer House, Chicago. W. J. Donald, 155 East Forty-fourth street, New York, is managing director.

Oct. 25-26—

Porcelain Enamel institute. Eighth annual meeting to be held in Cleveland. Further information may be obtained from the Institute at 612 North Michigan avenue, Chicago.

Dodge "D-V" (Double Value) Drives

COORDINATED Sheaves and Belts insure the maximum efficiency in machine design. Dodge *close-grained* iron sheaves with *smooth* grooves have no rough spots to fray belts. Dodge Belts cannot turn or shift because they have concave side walls, flexing over sheaves with a perfectly straight surface in contact with grooves. There are Dodge "D-V" (Double Value) Drives for every purpose. By specifying them, you can rely on the undivided responsibility of a single, reputable manufacturer. You are sure of "Matched Quality" that matches your own reputation.

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